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research and development in industry: 1987

funds, 1987
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Suggested Citation

National Science Foundation, *Research and Development in Industry: 1987*, NSF 89-323, Detailed Statistical Tables, available in paper copy and on diskette (Washington, D. C., 1989).

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general notes

- Data in this report were collected by the Bureau of the Census (Census), Department of Commerce for the National Science Foundation (NSF) in the Annual Survey of Industrial Research and Development and cover the periods 1956-87 for research and development (R&D) funding data and January 1957-January 1988 for R&D personnel data.
- Footnote "(D)" on the Detailed Statistical Tables, section B, is used to indicate data are being withheld to avoid possible disclosure of information about operations of individual companies. This occurs when a small number of companies, usually one or two, accounts for a large percentage of the R&D funds or of scientists and engineers in a particular data cell. Data showing Federal R&D support to companies in R&D-performing industries are most often affected by this rule.
- Footnote "(S)" on the Detailed Statistical Tables, section B, is used to indicate that the imputation rate—the percentage of the statistic estimated by Census staff—exceeds 50 percent. This means respondents failed to provide data for that item on the questionnaire. Users should consult table A-1 for imputation rates for specific items.
- The industry R&D survey does not cover trade associations. Although their primary mission is to serve industry, trade associations are established as nonprofit organizations and are included in the NSF nonprofit survey. R&D expenditures of trade associations are estimated at less than 1 percent of the industry R&D total.
- Complete technical notes are contained in section A. Questions regarding these survey findings should be addressed to Melissa Pollak or Mary Burke, Industry Studies Group, Division of Science Resources Studies, National Science Foundation, Washington, D. C. 20550 (202) 634-4648.

technical notes

- The annual Survey of Industrial Research and Development has been conducted for NSF by Census for the past 30 years.
- All companies, both foreign and domestic, that perform R&D in the United States are included or represented.
- All companies that annually spend more than \$1 million on R&D in the United States receive a survey form every year.
- Privately held companies are included.
- Respondents are provided detailed definitions to guide them on which expenses to include or exclude from the R&D data they provide.
- Census staff conduct the survey under Title 13 of the U.S. code which prohibits publication or release of data that may reveal information about individual companies.
- It is a company- rather than an establishment-based survey. Therefore, all R&D data for each company are placed within the major Standard Industrial Classification (SIC) code of the firm for

all tables, except those showing R&D expenditures by product field.

introduction

NSF first sponsored a survey of industrial R&D in 1953. Since then, the scope of the survey has gradually been expanded and refined in response to an increasing need for more detailed information on the Nation's R&D effort.

The 1987 survey of industrial R&D is the 31st in the annual series sponsored by NSF and conducted by Census. Industry Studies Group staff of NSF's Division of Science Resources Studies monitor the survey. NSF also sponsored two industrial R&D surveys covering the 1953-56 period that were conducted by the Bureau of Labor Statistics (BLS), Department of Labor.¹ Data obtained

in the BLS survey are not directly comparable with Census figures for 1957-87 because of methodological and other differences in the surveys conducted by the two agencies.

The primary focus of these data-gathering efforts is on U.S. industry as a *performer* of, rather than as a *source* of funds for, R&D. Thus, data on Federal support of R&D activities performed by industry are collected and appear in several tables, but data on industry support of R&D undertaken at colleges and universities and other nonprofit organizations are not collected.² They are, however, included in a table showing the total amount of R&D funds contracted to outside organizations.

The statistics presented in this report are subject to response and concept errors caused by different respondent interpretations of the

¹National Science Foundation, *Science and Engineering in American Industry. Final Report on a 1953-54 Survey* (NSF 56-16) and *Science and Engineering in American Industry, 1956* (NSF 59-50) (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1956 and 1960).

²Data on industry funding of R&D performed at universities and colleges are collected in the annual Survey of Scientific and Engineering Expenditures at Universities and Colleges. More information about this survey is available from the Universities and Colleges Studies Group of NSF's Division of Science Resources Studies, (202) 634-4673.

definitions of R&D activities provided in the survey instructions and by variations in company accounting procedures. Consequently, the data are better indicators of changes in, rather than absolute levels of, R&D spending and personnel.

Data quality has improved substantially since the first industry R&D survey was undertaken, mainly as a result of respondents' adoption of more accurate and sophisticated accounting procedures. In addition, NSF and Census staff have endeavored to reduce response and concept errors arising from difficulties in interpreting or applying survey definitions.

NSF staff are aware of the increased reporting burden placed on industry from all sources in recent years. To reduce this burden, the detailed questionnaire, which has been in use with slight modifications since the beginning of the survey, is now mailed only biennially, in odd-numbered years; abbreviated forms containing only the most crucial data elements are sent to survey respondents in the intervening, even-numbered years.

The shortened survey form was used for the first time to collect industrial R&D data for 1978. Because not all data elements were collected in even-numbered years, some historical tables do not contain data for these years, and other tables show prior-year, rather than current-year, data in even-numbered editions of this data series. The main tables affected are those that give detailed breakdowns of R&D expenditures for basic research, applied research, and development by industry (between 1978 and 1984)³ and by product field. Tables showing company-financed R&D contracted to outside organizations, Federal R&D support to industry by agency, R&D expenditures by geographic area, and some

detailed data on energy and pollution abatement R&D activities are also omitted in even-numbered years.

survey definitions⁴

Research and development—Basic and applied research in the sciences and engineering and the design and development of prototypes and processes. This definition excludes quality control, routine product testing, market research, sales promotion, sales service, research in the social sciences or psychology, and other nontechnological activities or routine technical services.

Basic research—Original investigations for the advancement of scientific knowledge not having specific immediate commercial objectives, although such investigations may be in fields of present or potential interest to the reporting company.

Applied research—Investigations directed to the discovery of new scientific knowledge having specific commercial objectives with respect to products or processes. This definition differs from that of basic research chiefly in terms of the objectives of the reporting company.

Development—Technical activities of a nonroutine nature concerned with translating research findings or other scientific knowledge into products or processes. Not included are routine technical services to customers or other activities excluded from the foregoing definition of R&D.

Funds for research and development—Operating expenses incurred by a company in the conduct of R&D in its own laboratories or other company-owned or -operated facilities. These expenses include wages and salaries, materials and supplies consumed, property and other taxes,

maintenance and repairs, depreciation, and an appropriate share of overhead, but exclude capital expenditures. All funds for R&D performance are expressed in current, rather than constant, dollars.

Company-financed research and development—Cost of company-sponsored R&D actually performed within the company. These data therefore do not include the cost of R&D supported by companies but contracted to outside organizations such as research institutions, universities and colleges, nonprofit organizations, or (to avoid double counting) other companies. Since this is a survey of R&D performers, industrial firms that undertake R&D supported by other companies, however, do report the funds received in payment for the R&D work they perform. These monies are classified under the industries of the performing companies.

Federally financed research and development—Receipts for work done by the company on Federal R&D contracts or subcontracts and R&D portions of procurement contracts and subcontracts.

Federally funded research and development centers (FFRDCs)—Organizations administered by industrial, educational, or other institutions on a nonprofit basis; they conduct R&D almost exclusively for use by the Federal Government. R&D expenditures of industry-administered FFRDCs are included in data showing Federal R&D support to industry under the industry classifications of the administering firms. See section C for a listing of industry-administered FFRDCs and their locations.

R&D scientists and engineers—The January number of those engaged full time in R&D and the full-time-equivalent (FTE) of those working part time in R&D. Scientist and engineers are defined as persons engaged in scientific or engineering work at a level that requires knowledge of physical, life, engineering, or mathematical science equivalent at least to that acquired

³Beginning in 1984, annual collection of basic research, applied research, and development data was resumed.

⁴For more detailed definitions, as well as the instructions for individual items covered in the survey questionnaire, see section D.

through completion of a 4-year college program with a major in one of those fields.

Employment—Total number of persons domestically employed by R&D-performing companies in all activities during the pay period that includes the 12th of March. These data are not completely comparable with the data on R&D scientists and engineers described in the foregoing paragraph because the earlier data were collected in January of each year.

Net sales and receipts—Recorded dollar values for goods sold or services rendered by R&D-performing companies to customers (outside the company), including the Federal Government, less such items as returns, allowances, freight, charges, and excise taxes. Domestic intra-company transfers and sales by foreign subsidiaries are excluded, but transfers to foreign subsidiaries and export sales to foreign companies are included.

Geographic area covered—Includes only those operations located in the 50 States and the District of Columbia.⁵

explanation of tabular data

Industry classification—Census Bureau staff assigned a company-level Standard Industrial Classification (SIC)⁶ code to each company. For multi-establishment companies, single SIC codes—representing the most dominant economic activity (in terms of total payroll)—were assigned. Data for the following industry groupings [with SIC code(s) shown in parentheses] are published in this report:

Food and tobacco (20, 21)⁷
Textiles and apparel (22, 23)
Lumber, wood products, and furniture (24, 25)
Paper and allied products (26)
Chemicals and allied products (28)
 Industrial chemicals (281-82, 286)⁸
 Drugs and medicines (283)
 Other chemicals (284-85, 287-89)⁸
Petroleum refining and extraction (13, 29)
Rubber products (30)
Stone, clay, and glass products (32)
Primary metals (33)
 Ferrous metals and products (331-32, 3398-99)
 Nonferrous metals and products (333-36)
Fabricated metal products (34)
Machinery (35)
 Office, computing, and accounting machines (357)
 Other machinery, except electrical (351-56, 358-59)
Electrical equipment (36)
 Radio and TV receiving equipment (365)
 Communication equipment (366)
 Electronic components (367)
 Other electrical equipment (361-64, 369)
Transportation equipment (37)
 Motor vehicles and motor vehicles equipment (371)
 Other transportation equipment (373-75, 379)
 Aircraft and missiles (372, 376)⁹
Professional and scientific instruments (38)
 Scientific and mechanical measuring instruments (381-82)
 Optical, surgical, photographic, and other instruments (383-87)

Other manufacturing industries⁷—printing and publishing (27), leather products (31), and miscellaneous manufacturing industries (39)

Nonmanufacturing industries—forestry (08); mining (10-12, 14); construction (15-17); transportation, communications, electric, gas, and sanitary services (40-49); wholesale and retail trade (50-59); finance, insurance, and real estate (60-67); personal and business services (72-73); health services (806-07); and engineering, accounting, research, management, and related services (87)

Company size-class—Companies are categorized by their total number of domestic employees. The following are the six company size-classes used in this report: fewer than 500 employees; 500 to 999 employees; 1,000 to 4,999 employees; 5,000 to 9,999 employees; 10,000 to 24,999 employees; and 25,000 or more employees.

Classification of reporting units—The company or corporate family that includes all establishments under common ownership or control is the basic reporting unit. All R&D expenditures and scientists and engineers of each company are classified into a single SIC code and size-category.

Cost per R&D scientist or engineer—The number of FTE R&D scientists and engineers used to estimate the cost per R&D scientist or engineer for 1957-87 is the arithmetic mean of the numbers of FTE R&D scientists and engineers reported for January in two consecutive years. This number is then divided into total, earlier-year, R&D expenditures, and the ratio is attributed to the earlier year. For example, the mean of the numbers of FTE R&D scientists and engineers in January 1987 and January 1988 is divided into total 1987 R&D expenditures for a total cost per R&D scientist or engineer in 1987.

Nonavailability of statistics—Many tables in section B contain one

⁷Until 1984, tobacco products (SIC 21) was included with "other manufacturing industries."

⁸The classification "Industrial chemicals" was revised to include SIC Group 286, Industrial organic chemicals. All current and historical tables were revised accordingly.

⁹Companies primarily engaged in the manufacture of ordnance and accessories, including complete guided missiles, are grouped with companies primarily engaged in the manufacture of aircraft and parts because of the close similarity of their R&D activities.

⁵Company-sponsored R&D performed outside the United States by foreign subsidiaries of U.S. domestic companies is reported in table B-11 but excluded from all other tables.

⁶Executive Office of the President, Office of Management and Budget, *Standard Industrial Classification Manual*, 1987 (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office).

or both of the following footnotes:

- “(D),” which is used to indicate data are being withheld to avoid possible disclosure of information about operations of individual companies. This occurs when a small number of companies, usually one or two, accounts for a large percentage of the R&D funds or of scientists and engineers in a particular data cell. Publication of data showing Federal R&D support to companies in R&D-performing industries is most often affected by this rule; and,
- “(S),” which is used to indicate that the imputation rate—the percentage of the statistic estimated by Census staff—exceeds 50 percent. This means respondents failed to provide data for that item on the questionnaire. Users should consult table A-1 for imputation rates for specific items.

Although data may be withheld from certain cells, they are always included in totals. In some instances, data withheld because of high imputation rates (footnote S above) can be derived by subtraction from higher-level totals. In such cases, the data user should be aware that the derived numbers are statistically unreliable. In *no* instance can data be derived that would disclose operations of individual companies (footnote D).

Method of computation—Because of rounding, detailed statistics in tables may not add to totals or sub-totals. Also, percentages were calculated on the basis of thousands of dollars and may differ from those based on rounded figures shown.

methodology of survey¹⁰

Data presented in this report are based on a probability sample,

selected and first used for survey year 1987. The universe from which the probability sample, or “panel,” was drawn includes companies in all manufacturing industries and a select number of nonmanufacturing industries known, on the basis of earlier samples, to conduct R&D. The sampling unit for this survey is the company, defined as a business organization consisting of one or more establishments under common ownership or control.

The Standard Statistical Establishment List (SSEL), which contains information on 3.5 to 4.0 million establishments (that are either entire companies or parts of companies) was the universe frame used to select the 1987 panel. Establishment-level data were summed, if necessary, to the company-level, and Census staff assigned a single SIC code—the SIC code of the establishment(s) having the highest dollar-value of payroll—to each company.

Several innovations were introduced into this most recent sample design to improve the quality of the sample vis-a-vis earlier sample designs. (The previous panel was selected and first used for the 1981 survey and was also used in subsequent annual surveys until 1987.)

frame creation

From the outset in the latest sample selection, the major goal was to eliminate from the frame, to the greatest extent possible, companies unlikely to have R&D programs. This would minimize the number of sampled companies without R&D activity. To accomplish this objective, two steps were taken:

1. NSF staff narrowed the list of “in scope” nonmanufacturing industries by eliminating those known to have little or no R&D activity. Thus, companies in the eliminated nonmanufacturing industries had no chance of being selected. This gave companies in the remaining non-

manufacturing or in manufacturing industries a greater probability of selection (than in past sample selections).

2. Additional companies—even some in “in scope” industries—were eliminated from the universe frame because they had fewer than a specified number of employees. An assumption was made that companies with only a small number of employees in some (for the most part nonmanufacturing) industries are unlikely to have R&D activity. Those companies were eliminated from the frame. NSF staff provided employment cutoffs for all industry groups; they are listed in table A-2.

In another effort to improve coverage of R&D-performing companies, NSF staff provided names of firms that were to be included in the sample with certainty. Most of these companies would have received questionnaires anyway because they met other established criteria; the few that did not were added to the panel.

In addition, Census staff reviewed lists of R&D contractors published by the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA) to ensure that all large industrial DOD and NASA R&D-performing contractors were included in the panel with certainty.

Further, all companies with more than 500 employees in “in scope” industries were sampled with certainty.

All certainty companies—on lists provided by NSF staff, on lists of DOD and NASA contractors, companies with more than 500 employees, and previous panel members—are self-representing, i.e., they have sampling weights of unity (1.00).

Based on (1) SIC code, (2) total employment cutoffs, (3) inclusion on an NSF, DOD, or NASA list, or (4) previous panel membership, approximately 154,000 companies were identified as “in scope” of the

¹⁰This section was prepared in the Industry Division of the Bureau of the Census, the collecting and compiling agent for the National Science Foundation.

Table A-1. Imputation rates for selected items on the research and development survey by industry: 1987

Industry	SIC code	[Percent]												
		Total R&D		R&D by type of cost			Fields by status		Energy R&D		Petroleum R&D	Other R&D		
		Sales	Employ- Scientists/engineers	Total	Cooperating	Federal R&D by agency	Wages	Materials	Other costs	Fields of basic research	R&D by status	Energy R&D	Petroleum R&D	Other R&D
Total.....		4.5	6.4	31.8	6.7	3.8	33.7	50.7	50.4	40.1	39.0	33.6	57.4	9.6
Distribution by industry														
Food, kindred, and tobacco products.....	20,21	9.2	13.6	53.4	5.0	0.0	94.7	63.2	64.1	62.0	41.3	63.4	5.8	0.0
Textiles and apparel.....	22,23	1.1	8.9	35.4	10.4	0.0	31.5	70.0	79.2	65.1	29.2	0.0	23.4	1.2
Lumber, wood products, and furniture.....	24,25	6.1	19.0	49.2	2.3	-	-	66.5	63.9	63.1	24.2	0.0	0.0	28.8
Paper and allied products.....	26	4.4	3.4	45.6	2.3	0.0	0.0	50.1	57.0	54.3	33.1	39.5	21.4	0.0
Chemicals and allied products.....	28	6.1	5.8	37.6	2.8	3.1	21.8	54.3	50.7	55.7	55.5	77.0	26.5	4.6
Industrial chemicals.....	281-42,286	8.2	7.0	54.6	2.9	3.1	20.4	52.3	40.1	45.7	82.4	81.7	30.8	1.6
Drugs and medicinal.....	283	1.9	1.7	38.8	1.2	0.0	51.2	58.5	60.5	58.0	40.5	0.2	7.8	1.9
Other chemicals.....	284-45,287-89	6.6	8.1	16.3	6.2	0.0	0.0	48.8	50.1	59.8	16.0	20.9	2.9	10.4
Petroleum refining and extractives.....	13,29	0.0	0.8	28.6	0.0	1.9	1.2	33.7	37.4	33.5	27.7	27.3	0.1	0.0
Rubber products.....	30	10.4	9.5	78.6	18.2	31.9	96.2	72.0	71.7	68.3	52.5	65.8	32.5	0.0
Stone, clay, and glass products.....	32	9.5	11.0	24.0	3.1	1.8	4.0	26.1	17.7	34.6	12.3	8.0	6.4	0.0
Primary metals.....	33	15.2	12.9	21.0	5.0	0.0	0.4	23.6	40.1	29.6	11.9	1.4	11.1	8.5
Nonferrous metals and products.....	331-32,3398-99	23.5	19.2	14.7	6.2	0.0	0.1	19.7	30.7	15.8	10.8	1.6	29.1	19.3
Other nonferrous metals and products.....	333-36	3.7	3.6	35.2	2.5	0.0	19.8	37.6	47.8	33.2	0.0	0.0	8.0	0.8
Fabricated metal products.....	34	13.3	9.5	57.6	4.9	0.0	65.3	83.8	77.8	80.6	28.6	1.3	0.6	0.0
Machinery.....	35	3.8	3.9	72.5	1.5	0.3	4.0	42.0	39.3	33.1	29.6	63.0	9.6	0.0
Office, computing, and accounting machines.....	357	1.9	2.1	11.4	1.0	0.1	0.9	33.6	29.1	21.8	65.2	0.0	-	0.8
Other machinery, except electrical.....	351-36,358-59	5.3	5.4	50.1	3.2	5.2	79.8	67.4	70.3	75.3	20.0	60.8	9.6	0.0
Electrical equipment.....	36	4.6	5.0	38.8	2.5	0.2	42.6	58.8	55.8	49.3	30.4	12.2	86.1	0.0
Radio and TV receiving equipment.....	363	4.6	9.5	18.8	2.3	-	-	98.3	98.6	98.9	0.0	-	-	-
Communications equipment.....	366	0.8	1.5	28.7	0.5	0.2	44.5	37.1	39.5	33.7	18.2	1.5	0.0	0.8
Electronic computers.....	367	15.4	13.0	49.2	7.8	0.5	64.0	86.1	87.4	85.6	48.4	93.3	32.4	2.4
Other electrical equipment.....	361-64,369	3.3	4.3	54.6	1.3	0.1	2.8	69.3	61.0	74.2	99.8	4.7	99.4	0.0
Transportation equipment.....	37	0.5	1.5	16.4	0.2	1.3	0.0	40.6	41.9	40.4	40.0	52.4	74.5	0.4
Motor vehicles and motor vehicle equipment.....	371	0.0	1.6	37.5	0.0	0.0	37.4	32.1	32.2	32.8	31.0	95.3	88.1	0.2
Other transportation equipment.....	373-75,379	2.3	2.4	53.6	0.4	0.0	88.7	63.4	61.8	64.1	0.0	0.0	0.0	0.5
Aircraft and missiles.....	372,376	0.9	1.4	7.4	0.2	1.1	0.0	44.7	45.9	42.2	13.8	43.2	8.9	0.5
Professional and scientific instruments.....	38	1.0	10.6	55.2	0.8	3.4	19.3	86.6	86.5	87.5	51.5	0.0	0.0	0.6
Scientific and mechanical measuring instruments.....	381-82	1.0	2.1	61.6	0.9	9.1	88.2	87.7	89.9	87.4	66.3	0.0	0.0	0.0
Optical, surgical, photographic, and other instruments.....	383-87	1.1	15.5	50.7	0.8	0.7	1.7	86.1	85.5	87.5	44.7	-	0.0	0.6
Other manufacturing industries.....	21,27,31,39	1.3	3.0	51.5	1.7	4.3	0.0	66.6	77.2	74.9	96.4	-	-	8.8
Nonmanufacturing industries.....	08,10-12,14-17, 40-47,72-73, 806-87,891	3.8	6.2	32.1	2.0	1.4	3.6	87.0	87.0	86.9	50.2	7.5	18.8	9.8

- Represents no basis for imputation.

Table A-2. Number of companies in the universe, sample, and panel

SIC Code	TE+ Cutoff	Universe	Selected for 1987 Sample	Certainities	Companies with Data for 1987	the 1988 RD-1 Panel
Manufacturing industries						
20,21	>= 250	762	421	410	150	70
22,23	>= 100	2,582	466	446	119	47
24,25	>= 100	1,518	234	213	98	45
26	>= 50	1,103	172	144	88	43
281-82,286	> 0	1,048	89	83	60	53
283	> 0	854	69	60	47	40
284-85,287-89	> 0	4,728	157	99	101	67
13,29	>= 100	566	113	94	50	35
30	>= 50	2,086	188	164	113	42
32	>= 50	1,306	179	123	79	29
331-32,3398-99	>= 20	1,188	144	116	55	18
333-36	>= 20	1,066	161	79	63	30
34	>= 20	10,046	503	276	215	72
357,358-59	> 0	1,707	150	136	121	114
351-56	>= 20	10,034	1,179	339	485	191
365	> 0	650	58	24	19	6
366	> 0	1,900	138	119	89	77
367	> 0	4,574	329	140	171	99
361-64,369	> 0	5,058	709	218	322	98
371	>= 250	159	99	98	67	38
373-75,379	>= 100	253	133	56	46	14
372,376	>= 250	86	57	57	49	28
381-82	> 0	2,363	268	87	171	78
383-87	> 0	3,437	185	93	113	72
27,31,39	>= 50	5,163	455	416	119	43
Total, manufac- turing industries		64,237	6,656	4,090	3,010	1,449
Nonmanufacturing industries						
10	>= 100	23	22	22	11	5
11	>= 100	72	25	25	5	3
14	>= 100	79	30	10	10	4
15	>= 50	3,157	185	150	10	1
16	>= 50	1,963	140	89	10	4
17	>= 250	433	139	129	12	2
40	>= 250	27	21	21	5	3
41	>= 250	96	41	29	0	0
42	>= 250	314	142	141	3	1
44	>= 250	88	54	50	3	0
45	>= 250	112	65	63	3	2
46	>= 50	19	12	8	1	1
47	>= 250	77	42	33	1	1
48	>= 20	2,860	115	88	18	10
49	>= 50	774	222	183	92	40
50	>= 250	665	274	270	33	34
53	>= 250	219	156	156	2	1
54	>= 250	594	309	307	10	4
56	>= 250	255	132	132	5	0
60	>= 500	387	387	387	9	6
62	>= 250	145	82	79	5	3
63	>= 250	854	592	590	26	16
72	>= 250	75	34	33	5	3
73	>= 250	3,541	329	303	37	27
737	> 0	16,302	475	108	139	59
7391	> 0				70	42
7392	>= 100	4,532	605	168	16	8
7397	> 0				6	1
78	>= 100	98	24	21	3	0
806	>= 1000	23	23	23	1	0
807	> 0	10,318	1,118	161	61	15
891	> 0	42,137	1,466	129	171	51
Total, nonmanufac- turing industries		90,239	7,261	3,908	783	347
Total, all industries		154,476	13,917	7,998	3,793	1,796
*Total employment						

SOURCE: U.S. Department of Commerce, Bureau of the Census

survey and therefore were included in the sampling frame. The effect of the new efforts aimed at improving coverage is demonstrated by a sharp reduction in the size of the total universe; it dropped from about 450,000 companies in the 1981 sampling frame to 154,000 companies in the latest operation (table A-2).

It is likely that a small number of companies actually engaged in R&D activity were omitted from the frame as a result of these first-time sample selection operations. It was agreed, however, that the benefit derived from the new operations—greater sampling efficiency resulting in improved national estimates of industrial R&D expenditures and employment—far outweighed the cost.

probability proportionate to size

As with most types of economic surveys, the sample selection process for the industrial R&D survey used probabilities proportionate to size. That is, "large" companies have a proportionately higher probability of selection than do "small" companies, where large or small is measured relative to the statistic being estimated.

For the R&D survey, size should be determined by the amount of a company's R&D expenditures. Unfortunately, except for the portion of the universe frame that was in the current panel, it was impossible to know what these R&D expenditure values were. One logical solution was to impute each company's R&D expenditures and base the probability of selection on these imputed values. (The same strategy was employed in the 1981 sampling operation.)

Each company was assigned a probability of selection, based on the size of its estimated R&D expenditures. The size of each company's R&D expenditures was estimated by

Census using a relationship linking the size of its R&D expenditures to its employment.¹¹ [This relationship was developed for each SIC from data collected in the then most recent (1985) R&D survey.] Thus, within each SIC, the larger the number of employees, the higher the probability of selection for inclusion in the sample.

Clearly, this strategy has some weaknesses. Even with refinement of the universe frame, as described in the foregoing section, a large number of companies on the frame have no R&D activity. But this procedure treated all companies as if they do. Although they might not have been assigned the most appropriate measure of size and, hence, probability of selection, it is reasonable to assume that large companies are more likely to have R&D programs than small companies (thus giving large companies greater probability of selection) rather than to treat all companies equally. An additional consequence of this assumption is discussed later.

One further adjustment was applied that was not made in previous sample selections. This was based on the assumption that multi-establishment companies of a given size and in a given industry would on average be expected to have more R&D activity than single-establishment companies of the same size and in the same industry. Once again, 1985 panel data were used to develop this adjustment factor. Finally, it should be noted that for companies in the previous panel, their actual reported R&D activity was used in lieu of an imputed value and was not adjusted.

¹¹Since company employment was known for the universe, it was possible to use this relationship to impute R&D expenditures values for all companies in the frame.

sample allocation and relative standard error constraints

The sampling program utilized for this operation allowed parameters to be assigned permitting the sample to be allocated across various levels or strata that correspond to industry groupings. This procedure permitted a desired sample size and a desired sampling error to be achieved for each strata. Estimated errors of total R&D estimates for these strata were not to exceed certain levels. The only constraint in achieving these results was that the total sample size across all the strata could not exceed 12,000-13,000 companies. (The amount of funds NSF provided determined the size of the sample to be drawn.) NSF staff provided relative rankings for each industry group—high, medium, or low—to determine the precision of the estimate. An actual translation to what high, medium, or low meant specifically could not be determined until Census staff arbitrarily investigated several sampling error levels, computed what sample size these levels implied, and applied the constraint of the total sample size of 13,000. The result of this investigation led to the following criteria:

- a. High precision:
sampling error not to exceed 2%
- b. Medium precision:
sampling error not to exceed 5%
- c. Low precision:
sampling error not to exceed 10%

Based on the desired precision these criteria suggested a total sample size of approximately 13,500. This number was not excessively beyond the stated limit of 13,000, so this was the sample size parameter decided on for the selection process.

One limitation should be noted. Sampling errors were controlled using a universe total that in large part was improvised; that is, and as noted above, an R&D value was

assigned to every frame record, although in reality many companies in the sampling frame have no R&D expenditures. The value was an imputed value for the great majority of companies in the frame. As a consequence, the estimated universe and the distribution of individual company values bore little resemblance to reality. Estimates of sampling variability were nevertheless based on this distribution. The presumption was—and this had been confirmed in the previous sample selection—that actual variation would be less than that estimated because so many of the sampled companies have true R&D values of zero, not the widely varying values that were imputed. Thus, the 2 percent, 5 percent, and 10 percent error levels described above are conservative.

The particular sample selected is one of a large number of samples of the same type and size that, by chance, might have been selected. Estimates from each of the different samples would differ somewhat from each other and from the results of a complete canvass conducted under essentially the same conditions as the survey.

In addition to sampling error, the estimates are subject to nonsampling error that would also occur if a complete canvass were to be conducted under the same conditions (table A-3).

sample selection

The sample selection program was run with a specified sample size (expected) of 13,500 and with other parameters set to assure compliance with the relative standard error constraints. An actual sample of 13,917 was selected. There are two reasons why the actual sample size differs from the specified:

First, the program uses independent sampling. Each company had an independent chance of selection based on its assigned probability; the selection (or nonselection) of a com-

pany was completely independent of the selection of any other company.

In independent sampling, sample size is itself a random variable. Theoretically, a sample of size 0 or a sample the size of the entire universe is possible, but the probabilities of these extremes are so small that these are nearly impossible situations. The actual sample size is usually quite close to the specified size. If there is too much deviation, the program is simply executed again.

Second, a minimum probability rule was imposed. As noted earlier, the sampling program assigns probabilities proportionate to size (where size in this case is the imputed R&D value assigned each company). Selected companies that are vastly larger than their assigned values can have adverse effects on the estimates once the data are collected. To lessen these effects, the maximum weight a company can assume was arbitrarily controlled by specifying that the probability of selection cannot be less than a certain value. If the probability based on its size is less than this minimum value, then it is set equal to this value. The consequence of raising these original probabilities to the minimum probability is to raise the expected sample size. It is likely that most of the difference between the specified sample size and the actual sample size is due to this rule.

the annual panel

A panel is a group of companies that receives a survey questionnaire, the RD-1, annually. The following is a description of how the new panel was formed from the sample.

The basic tool for the survey is Form RD-1, which is used to collect detailed R&D information. Companies in the new sample that were in the old panel and had received a 1986 RD-1 form (1,095 companies) once again received an RD-1 form for 1987. The remaining certainty (6,903) and non-

certainty (5,919) companies in the new sample received an RD-1A survey form for 1987. Form RD-1A is an abbreviated version of RD-1 and is generally mailed to companies only in the year in which a new sample is drawn. The purpose is to canvass, with a minimum of reporting burden, smaller R&D performers.

Of the 13,917 companies that received a form, 3,793 respondents reported that their companies had R&D expenditures. The 3,793 companies were ranked by total R&D (both companies' own and Federal) funds within each SIC code. All companies with over \$1 million in total R&D expenditures were placed on the RD-1 panel. In some industries, companies with less than \$1 million in R&D expenditures were also added to the panel to ensure 95 percent coverage of the R&D total for each industry. All companies on the panel will receive the RD-1 questionnaire annually until the next sample is drawn. The other RD-1A companies (with less than \$1 million in R&D expenditures) will not receive another questionnaire; their data will be estimated, using their 1987 reports, in subsequent years by Census staff.

The RD-1 panel increased from 1,095 companies in 1987 to 1,795 companies in 1988. A few companies report by establishment on more than one form. Accounting for multiple reports from companies, the number of mailing units increased from 1,252 to 1,946 for 1988.

Table A-2 contains information, by industry, on the number of companies in the sample having R&D expenditures and the composition of the 1988 RD-1 annual survey panel.

The survey questionnaires were mailed in January 1988, and nonrespondents received followup letters by mail. Since total R&D expenditures, Federal R&D funds, net sales, and employment are included in Census' mandatory statistical program, Form MA-121s, which are used to collect these mandatory items, were mailed to the few companies that had not returned Form RD-1 for 1986.

Table A-3. Standard error of estimate (percentage) of funds for R&D performance for all company size-groups and for companies with fewer than 1,000 employees by industry: 1987

Industry	SIC code	Standard error of companies with fewer than 1,000 employees	Standard error of estimate (1)
Total.....	.....	0.9	7.3
Food, kindred, and tobacco products.....	20,21	0.0	0.0
Textiles and apparel.....	22,23	6.5	35.0
Lumber, wood products, and furniture.....	24,25	0.6	6.2
Paper and allied products.....	26	4.0	39.5
Chemicals and allied products.....	28	2.6	36.6
Industrial chemicals.....	281-82,286	0.5	22.1
Drugs and medicines.....	283	0.8	31.4
Other chemicals.....	284-85,287-89	13.6	47.6
Petroleum refining and extraction.....	13,29	0.2	27.1
Rubber products.....	30	4.6	48.3
Stone, clay, and glass products.....	32	6.5	67.8
Primary metals.....	33	0.9	23.0
Ferrous metals and products.....	331-32,3398-99	0.9	29.8
Nonferrous metals and products.....	333-36	2.1	35.1
Fabricated metal products.....	34	21.3	46.0
Machinery.....	35	3.5	21.5
Office, computing, and accounting machines.....	357	2.2	29.7
Other machinery, except electrical.....	351-56,358-59	13.2	28.7
Electrical equipment.....	36	1.8	16.8
Radio and TV receiving equipment.....	365	4.6	26.4
Communication equipment.....	366	2.3	42.3
Electronic components.....	367	4.8	22.5
Other electrical equipment.....	361-64,369	1.6	13.5
Transportation equipment.....	37	0.1	32.0
Motor vehicles and motor vehicles equipment.....	371	0.4	63.7
Other transportation equipment.....	373-75,379	1.3	27.2
Aircraft and missiles.....	372,376	0.0	0.0
Professional and scientific instruments.....	38	1.6	10.4
Scientific and mechanical measuring instruments....	381-82	2.0	8.2
Optical, surgical, photographic, and other instruments.....	383-87	2.1	19.4
Other manufacturing industries.....	27,31,39	1.7	12.2
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	5.1	10.2

(1) A description of the standard error of estimate is given in section A under "Methodology of Survey." The percentage (or relative) standard errors in this table may be converted to standard errors of estimate by multiplying the percentages shown by the associated estimates. For example, the relative standard error of estimate for R&D performance for all company size-groups in the chemicals industry (SIC 28) is shown as 2.6 percent, and the associated total R&D estimate for this industry is shown as \$9,831 million in table B-3, "Funds for research and development by industry and size of company." The standard error of estimate, then, is .026 times 9,831 or 255.61.

When companies fail to provide the requested information, the missing data are estimated by using industry averages and several different methodologies that rely on data provided in earlier years. Table A-1 contains imputation rates for the principal survey items.

comparability of data over a period of several years

Several procedures are undertaken to maintain the reliability of the industry R&D time series:

two-year comparability

Before mailing the survey forms each year, data reported by respondents the previous year—or two years earlier for items asked only in odd-numbered years—are imprinted on the questionnaires. Respondents are asked to adjust data for the previous year(s) as necessary to make them comparable to data provided for the current year. Such adjustments are necessitated, for example, by changes in reporting concepts or changes in company structure. Thus, there is comparability in data from the survey over any 2-year period. To maintain consistency, the employment-size classification of any company affected by such changes is adjusted so that the company is tabulated in the same employment-size category for two consecutive years.

These adjustments can be examined by comparing data for the same year reported in two succeeding periods, e.g., 1986 data appearing in the 1985–86 edition of *Research and Development in Industry* may differ from 1986 data in this volume. Totals for broad classifications are likely to be very close in the two editions; larger differences are more noticeable in the finer detail. These differences underscore the point that the

measures are approximate and indicative rather than precise.

historical data revisions

The industry R&D survey data are revised periodically, usually because of changes in company SIC classifications. Companies may shift from one industry into another because of any of the following: (1) the growth and/or decline of product lines, (2) the merger of two or more companies, (3) the acquisition of one company by another, (4) divestiture, or (5) the formation of conglomerates. If Census Bureau staff are aware of the year in which changes #2, #3, #4, or #5 occurred (respondents are asked about changes in ownership on the questionnaire), data are reclassified in the new industry for the year the change actually occurred. If a change was not discovered until the selection of a new panel or if it could not be determined when a shift actually occurred (i.e., #1), other methodologies were used to move a company out of one industry and into another. Since 1967, three revisions in the data covering the periods 1967-76, 1976-81, and 1981-87 were made to adjust data of companies that changed industries. These are described below.

the 1967-76 period

The SIC codes assigned to companies in the panel for the years 1967 through 1975 were based on data reported in the 1967 census. The 1974 SSEL file was used to assign SIC codes to companies in the next panel chosen for the 1976 survey and for revised 1975 data received in the 1976 survey. The SIC codes of companies in the 1967 and 1976 panels were examined to determine which companies had changed classifications. Since it was not known in which year changes actually occurred, data of companies that had changed SIC codes were revised for the years 1968 through

1974 to smooth the changes over the period 1967-76. To illustrate, if a company was originally in SIC A in 1967 but was discovered to be in SIC B in 1974, its data for 1967-74 were allocated between the two industries as follows: 1967—all of the company's data was retained in industry A; 1968—14.3 percent of the company's data was allocated to industry B, and the remainder retained in industry A; 1969—28.6 percent was allocated to industry B, and the remainder retained in industry A; and so on until 1974, when all of the company's data was allocated to industry B.

the 1976-81 and 1981-87 periods

Similar revisions in the industry R&D data were made for companies in the panels drawn in 1976 and 1981 used for the years 1976-80 and 1981-87, respectively, but a different methodology was used.

When the most recent panel (1987) was selected, companies were assigned SIC codes from the SSEL File. Prior-year (1986) data were collected in the 1987 survey. These 1986 data were presumed to be more accurate than those collected in the 1986 survey because they not only reflected updated SIC codes, but also were obtained from a larger panel providing better coverage of U.S. industry (see table A-4.) Thus data obtained for 1981-86 using the panel selected in 1981 were revised subject to the following constraints:

1. Data for 1981 (revised from the 1982 survey) would remain unchanged since this was the first year the 1981 panel was used and that panel was an accurate reflection of company SIC codes in that year.
2. Data for 1986 collected in the 1987 survey would be used instead of the 1986 data collected in the 1986 survey.

Table A-4. 1986 R&D funds collected on the 1986 and 1987 surveys(1)

[Dollars in millions]							
Industry	SIC code	Company R&D			Reasons for revisions		
		1986 R&D from 1986 survey	1986 R&D from 1987 survey	Difference (B) - (A)	Industry shifts	Date revisions	New sample
		(A)	(B)	(C)	(D)	(E)	(F)
Total.....		\$52,847	\$61,725	\$8,878	0	586	8,292
Distribution by industry							
Food, kindred, and tobacco products.....	20,21	1,083	1,535	452	-21	329	144
Textiles and apparel.....	22,23	157	246	89	19	1	69
Lumber, wood products, and furniture.....	24,25	175	188	13	-78	9	82
Paper and allied products.....	26	887	538	-349	-408	3	56
Chemicals and allied products.....	28	8,773	8,656	-117	-204	-257	344
Industrial chemicals.....	281-82,286	3,812	3,374	-438	-96	-378	36
Drugs and medicines.....	283	3,785	3,654	-131	-215	97	-13
Other chemicals.....	284-85,287-89	1,176	1,628	452	107	24	321
Petroleum refining and extraction.....	13,29	1,867	1,971	104	87	(2)	17
Rubber products.....	30	776	869	93	51	-57	99
Stone, clay, and glass products.....	32	489	942	453	402	-2	53
Primary metals.....	33	809	813	4	-137	5	136
Ferrous metals and products.....	331-32,3398-99	388	395	7	-114	1	120
Nonferrous metals and products.....	333-36	421	418	-3	-23	4	16
Fabricated metal products.....	34	544	1,021	477	-47	18	506
Machinery.....	35	9,239	10,862	1,623	-421	341	1,703
Office, computing, and accounting machines.....	357	6,875	7,894	1,019	-185	388	816
Other machinery, except electrical.....	351-56,358-59	2,364	2,968	604	-236	-47	887
Electrical equipment.....	36	10,460	10,118	-342	-1,298	118	838
Radio and TV receiving equipment.....	365	208	133	-75	-52	(2)	-23
Communication equipment.....	366	5,155	5,211	56	-239	312	-17
Electronic components.....	367	2,537	3,340	803	190	-3	616
Other electrical equipment.....	361-64,369	2,561	1,434	-1,127	-1,197	-190	260
Transportation equipment.....	37	11,530	13,468	1,938	1,612	124	202
Motor vehicles and motor vehicles equipment.....	371	7,253	7,189	-64	61	-214	89
Other transportation equipment.....	373-75,379	137	330	193	88	94	11
Aircraft and missiles.....	372,376	4,141	5,949	1,808	1,463	244	101
Professional and scientific instruments.....	38	4,576	4,855	279	-99	-43	421
Scientific and mechanical measuring instruments.....	381-82	1,959	1,518	-441	-344	-231	134
Optical, surgical, photographic, and other instruments.....	383-87	2,617	3,337	720	245	188	287
Other manufacturing industries.....	27,31,39	381	381	0	-29	3	26
Nonmanufacturing industries.....	00,10-12,14-17, 40-67,72-73, 806-07,891	1,099	5,262	4,163	571	-4	3,596

(1) The difference between the two sets of 1986 estimates can be accounted for by companies which have switched industries (column D), companies which have revised their data (column E), and sampling variation (column F).

(2) Less than \$0.5 million.

SOURCE: U.S. Department of Commerce, Bureau of the Census

An algorithm was used to link data from 1981 with those collected in 1987, preserving, to the greatest extent possible, year-to-year trends in data for each industry by revising data for the years 1982, 1983, 1984, and 1985. Interested persons should

contact the Census Bureau to obtain further information about the construction and content of the algorithm.

The following data elements were adjusted using the methodologies just described: Funds spent on R&D

(total, Federal, and companies' own); number of FTE R&D scientists and engineers; total and company R&D funds as a percent of net sales; cost per R&D scientist or engineer; and basic research expenditures. No adjustments were made in other data elements.

detailed statistical tables

In all tables of this report:

- Because of rounding, details may not add to totals.
- Percentages were calculated on the basis of thousands of dollars and may differ from those based on the rounded figures shown.

To obtain accurate historical data, use only the latest detailed statistical tables and not data published earlier. Data presented in trend tables are assembled from the most recently completed survey cycle. Data for prior years are reviewed for consistency with current-year responses and, when necessary, are revised. For that reason, references to prior-year data should be restricted to those published in this document.

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[Dollars in millions]

Year	Total R&D		Federal		Company(1)	
	Current dollars	Constant 1982 dollars	Current dollars	Constant 1982 dollars	Current dollars	Constant 1982 dollars
1953.....	\$3,630	\$14,021	\$1,430	\$5,523	\$2,200	\$8,497
1954.....	4,070	15,475	1,750	6,654	2,320	8,821
1955.....	4,640	17,090	2,180	8,029	2,460	9,061
1956.....	6,605	23,530	3,328	11,856	3,277	11,674
1957.....	7,731	26,585	4,335	14,907	3,396	11,678
1958.....	8,389	28,274	4,759	16,040	3,630	12,235
1959.....	9,618	31,597	5,635	18,512	3,983	13,085
1960.....	10,509	33,955	6,081	19,648	4,428	14,307
1961.....	10,908	34,917	6,240	19,974	4,668	14,942
1962.....	11,464	35,892	6,434	20,144	5,029	15,745
1963.....	12,630	38,981	7,270	22,438	5,360	16,543
1964.....	13,512	41,032	7,720	23,444	5,792	17,589
1965.....	14,185	41,992	7,740	22,913	6,445	19,079
1966.....	15,548	44,474	8,332	23,833	7,216	20,641
1967.....	16,385	45,590	8,365	23,275	8,020	22,315
1968.....	17,429	46,194	8,560	22,688	8,869	23,506
1969.....	18,308	46,023	8,451	21,244	9,857	24,779
1970.....	18,067	42,986	7,779	18,508	10,288	24,478
1971.....	18,320	41,280	7,666	17,274	10,654	24,006
1972.....	19,552	42,056	8,017	17,245	11,535	24,812
1973.....	21,249	42,893	8,145	16,441	13,104	26,451
1974.....	22,887	42,415	8,220	15,234	14,667	27,181
1975.....	24,187	40,781	8,605	14,509	15,582	26,272
1976.....	26,997	42,805	9,561	15,159	17,436	27,645
1977.....	29,825	44,330	10,485	15,584	19,340	28,746
1978.....	33,304	46,115	11,189	15,493	22,115	30,622
1979.....	38,226	48,652	12,518	15,932	25,708	32,720
1980.....	44,505	51,919	14,029	16,366	30,476	35,553
1981.....	51,810	55,140	16,382	17,435	35,428	37,705
1982.....	59,010	59,010	18,534	18,534	40,476	40,476
1983.....	65,694	63,252	20,657	19,889	45,037	43,363
1984.....	76,087	70,627	23,356	21,680	52,731	48,947
1985.....	85,610	77,161	27,130	24,452	58,480	52,708
1986.....	89,896	78,905	28,171	24,727	61,725	54,178
1987.....	96,305	81,843	31,403	26,687	64,902	55,156

(1) Company funds include all funds for industrial R&D work performed within company facilities from all sources (e.g. outside organizations such as research institutions, universities and colleges, other nonprofit organizations, and state governments, as well as companies' own funds) except funds provided by the Federal Government. Company-financed research and development contracted to outside organizations (except other companies) is excluded.

NOTE: The 1982 GNP implicit price deflator was used to convert current to constant dollars.

Table B-2. Selected data for companies performing research and development by industry: 1986-87

[Dollars in millions]													
Industry(1)	SIC code	Total		R&D Funds Federal		Company		Net sales		R&D scientists/ engineers January		Total employment (in thousands)	
		1986	1987	1986	1987	1986	1987	1986	1987	1987	1988	1986	1987
Total.....		\$89,896	\$96,305	\$28,171	\$31,403	\$61,725	\$64,902	\$2,125,721	\$2,253,808	703.8	725.8	17,111	17,645
Food and kindred products.....	20	1,168	(D)	(D)	2	(D)	(D)	172,390	180,965	(D)	(S)	1,101	1,143
Tobacco manufactures.....	21	(D)	(D)	0	0	(D)	(D)	36,629	32,826	(D)	2.2	194	155
Textile mill products.....	22	205	183	0	0	205	183	37,694	42,187	1.9	1.8	477	494
Apparel.....	23	(D)	(D)	(D)	(D)	41	44	11,507	12,732	0.6	0.6	209	204
Lumber and wood products, except furniture.....	24	39	41	0	0	39	41	8,662	9,716	0.4	0.4	72	79
Furniture and fixtures.....	25	149	99	0	0	149	99	13,789	15,521	(S)	(S)	217	232
Paper and allied products.....	26	(D)	(D)	(D)	(D)	538	611	74,487	86,845	5.8	6.3	537	558
Printing, publishing, and allied industries.....	27	(D)	(D)	(D)	(D)	145	151	21,419	23,310	(S)	(S)	238	247
Chemicals and allied products.....	28	8,837	9,831	181	193	8,656	9,638	169,553	185,697	73.0	74.9	1,056	1,095
Petroleum refining and extraction.....	13,29	(D)	1,899	(D)	14	1,971	1,865	182,523	182,068	8.6	9.5	491	454
Rubber products.....	30	(D)	(D)	(D)	(D)	869	789	39,013	43,121	(S)	(S)	489	536
Leather and leather products.....	31	17	16	0	0	17	16	2,203	2,557	(S)	(S)	15	16
Stone, clay, and glass products.....	32	951	1,024	9	10	942	1,014	38,662	39,014	8.6	8.6	393	358
Primary metals.....	33	(D)	(D)	(D)	(D)	813	744	79,398	88,264	13.2	11.2	541	527
Fabricated metal products.....	34	1,116	1,120	95	86	1,021	1,034	58,048	66,719	(S)	(S)	579	627
Machinery.....	35	(D)	(D)	(D)	(D)	10,862	11,409	146,230	149,609	103.0	103.9	1,447	1,419
Electrical equipment.....	36	15,712	16,920	5,594	5,859	10,118	11,061	190,158	206,574	135.7	139.7	2,092	2,119
Transportation.....	37	30,423	33,393	16,954	19,930	13,468	13,463	377,817	391,803	176.0	180.8	2,619	2,703
Professional and scientific instruments.....	38	5,206	5,456	352	273	4,855	5,183	58,286	62,140	(S)	(S)	651	626
Miscellaneous manufacturing industries.....	39	(D)	(D)	(D)	(D)	219	225	8,439	9,428	3.9	4.3	82	93
Electric, gas, and sanitary services.....	49	537	548	4	11	533	537	139,130	137,691	1.5	1.6	556	558
Miscellaneous business services.....	73	4,681	5,226	1,805	1,939	2,876	3,287	29,607	36,480	49.9	57.7	367	397
Miscellaneous services.....	89	1,443	1,521	765	844	678	677	16,031	15,414	21.0	22.8	199	219
Other nonmanufacturing industries.....	08,10-12,14-17, 40-48,50-67,72, 806-07	1,209	1,448	(S)	(S)	1,175	1,411	214,046	233,127	(S)	(S)	2,489	2,786

(1) Industries, industry groups, and product fields shown separately in statistical tables are classified according to Standard Industrial Classification (SIC) manual codes.

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of more than 50 percent.

SOURCE: National Science Foundation, SRS

Table B-3. Companies' own and Federal funds for industrial R&D performance by industry and size of company: 1956, 1958, 1963, 1967, 1972, and 1977-87

(Dollars in millions)

Industry and size of company	DIC code	1956	1958	1963	1967	1972	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total.....		86,605	88,389	812,630	816,385	819,552	829,825	833,304	838,226	844,501	851,810	859,010	865,694	876,087	885,410	889,894	896,305
Distribution by industry																	
Food, kindred, and tobacco products(1).....	20-21	64	83	130	183	259	415	472	528	620	(B)	(B)	(B)	(B)	(B)	(B)	1,402
Textiles and apparel.....	22,23	(B)	26	30	57	61	83	89	101	115	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Lumber, wood products, and furniture.....	24,25	(B)	12	11	12	64	123	126	139	140	161	164	174	189	182	188	140
Paper and allied products.....	26	36	42	49	128	189	333	387	445	495	(B)	566	(B)	(B)	(B)	(B)	(B)
Chemicals and allied products.....	28	641	792	1,239	1,507	1,932	3,202	3,580	4,038	4,636	5,625	6,404	7,185	7,927	8,540	8,877	9,831
Industrial chemicals.....	281-82,286	460	553	809	966	1,031	1,668	1,798	1,962	2,197	2,802	3,204	3,214	3,240	3,498	3,552	3,879
Drugs and medicines.....	283	94	128	216	343	407	1,117	1,308	1,517	1,777	(B)	(B)	(B)	(B)	(B)	3,656	(B)
Other chemicals.....	284-85,287-89	87	111	214	198	294	617	474	589	662	(B)	(B)	(B)	(B)	(B)	1,628	(B)
Petroleum refining and extraction.....	13,29	182	246	317	371	468	918	1,868	1,262	1,282	(B)	(B)	(B)	(B)	(B)	(B)	1,899
Rubber products.....	30	(B)	89	156	182	377	491	493	577	656	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Glass, clay, and glass products.....	32	68	75	100	136	183	287	324	356	406	(B)	(B)	(B)	(B)	(B)	951	1,024
Primary metals.....	33	90	131	183	242	277	538	560	634	728	878	999	1,108	(B)	(B)	(B)	(B)
Ferrous metals and products.....	331-32,3398-99	(B)	80	104	135	166	284	314	375	443	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Nonferrous metals and products.....	333-34	(B)	51	77	107	130	254	246	259	285	(B)	(B)	(B)	329	394	423	452
Fabricated metal products.....	34	116	162	153	163	253	386	384	455	550	624	638	764	1,023	1,817	1,116	1,120
Machinery.....	35	543	781	958	1,326	2,158	3,880	4,283	4,825	5,901	6,818	8,065	8,861	10,511	12,083	(B)	(B)
Office, computing, and accounting machines.....	357	(2)	(2)	(2)	(2)	1,456	2,655	2,883	3,214	3,962	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Other machinery, except electrical.....	351-56,358-59	(3)	(3)	(3)	(3)	(3)	1,225	1,400	1,611	1,939	(B)	(B)	(B)	(B)	(B)	3,044	2,960
Electrical equipment.....	36	1,516	1,969	2,868	3,867	4,680	5,886	6,507	7,824	9,175	10,329	11,218	13,054	14,377	15,236	15,712	16,920
Radio and TV receiving equipment.....	363	(4)	(4)	(4)	45	48	96	130	245	356	(B)	(B)	(B)	(B)	(B)	133	143
Communication equipment.....	366					2,583	2,725	2,999	3,435	4,024	4,758	5,758	7,133	8,354	8,862	9,923	9,538
Electronic components.....	367	(B)	868	1,773	2,425	330	770	902	1,169	1,547	1,573	1,739	2,165	2,823	3,373	(B)	(B)
Other electrical equipment.....	361-64,369	(B)	1,101	1,093	1,397	1,719	2,295	2,474	2,775	3,048	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Transportation equipment.....	37	2,826	3,465	5,802	7,023	6,960	10,511	11,546	12,709	14,315	(B)	(B)	(B)	(B)	(B)	30,423	33,393
Motor vehicles and motor vehicles equipment.....	371					1,954	3,358	3,879	4,509	4,955	4,806	4,797	5,318	6,057	6,984	(B)	(B)
Other transportation equipment.....	373-75,379	688	856	1,090	1,354	56	120	131	159	162	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Aircraft and missiles.....	372,376	2,138	2,609	4,712	5,669	4,950	7,033	7,536	8,041	9,198	11,968	14,272	15,089	18,204	21,229	20,180	23,506
Professional and scientific instruments.....	38	200	294	284	542	838	1,571	1,998	2,505	3,029	3,614	3,946	4,290	4,648	5,097	5,268	5,456
Scientific and mechanical measuring instruments.....	381-82	97	156	70	104	163	452	670	950	1,352	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Optical, surgical, photographic, and other instruments.....	383-87	103	138	214	438	675	1,119	1,328	1,555	1,677	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Other manufacturing industries.....	27,31,39	(B)	105	54	90	146	243	266	288	364	(B)	(B)	(B)	(B)	(B)	383	(B)
Nonmanufacturing industries.....	00,10-12,14-17, 40-47,72-73, 806-87,891	(B)	117	276	559	707	958	1,229	1,540	1,815	1,906	2,501	3,421	5,125	7,087	7,870	8,743
Distribution by size of company (based on number of employees)																	
less than 500.....		369	532	619	687	929	1,353	1,438	1,764	2,065	2,385	3,156	4,776	5,109	6,671	8,139	8,844
500 to 999.....															1,565	1,848	2,131
1,000 to 4,999.....		350	642	1,022	1,017	1,215	1,524	1,931	2,483	2,781	3,148	3,900	4,184	5,598	6,286	7,443	8,079
5,000 to 9,999.....					892	1,076	1,829	1,551	1,691	2,828	2,988	2,822	2,972	3,576	4,410	4,771	5,129
10,000 to 24,999.....		5,686	7,215	10,989		2,159	3,418	4,278	5,191	6,817	6,762	7,826	9,831	10,596	10,370	10,155	12,423
25,000 or more.....					13,790	14,173	21,699	24,106	27,097	31,693	36,607	41,306	44,731	49,643	56,025	57,257	59,851

(B) Data have been withheld to avoid disclosing operations of individual companies.

(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

(2) Data not tabulated at this level prior to 1972.

(3) Data not tabulated at this level prior to 1977.

(4) Included in the other electrical equipment group.

Table B-4. Companies' own and Federal funds for industrial R&D performance by industry and size of company: 1987

[Dollars in millions]

Industry	SIC code	Companies with total employment of--						
		Total	Less than 500	500 to 999	1,000 to 4,999	5,000 to 9,999	10,000 to 24,999	25,000 or more
Total.....		\$96,305	\$8,844	\$1,979	\$8,079	\$5,129	\$12,423	\$59,851
Food, kindred, and tobacco products.....	20,21	1,402	5	48	157	(D)	(D)	(D)
Textiles and apparel.....	22,23	(D)	(D)	(D)	58	8	52	68
Lumber, wood products, and furniture.....	24,25	140	3	(D)	63	14	48	(D)
Paper and allied products.....	26	(D)	49	12	86	61	294	(D)
Chemicals and allied products.....	28	9,831	(D)	139	1,223	(D)	(D)	(D)
Industrial chemicals.....	281-82,286	3,879	39	(D)	(D)	405	(D)	(D)
Drugs and medicines.....	283	(D)	(D)	(D)	(D)	(D)	2,631	(D)
Other chemicals.....	284-85,287-89	(D)	451	80	390	0	546	(D)
Petroleum refining and extraction.....	13,29	1,899	6	(D)	57	(D)	(D)	(D)
Rubber products.....	30	(D)	(D)	24	(D)	113	(D)	(D)
Stone, clay, and glass products.....	32	1,024	78	19	46	(D)	192	(D)
Primary metals.....	33	(D)	(D)	(D)	208	(D)	(D)	(D)
Ferrous metals and products.....	331-32,3398-99	(D)	12	(D)	(D)	62	41	(D)
Nonferrous metals and products.....	333-36	452	(D)	10	(D)	(D)	(D)	(D)
Fabricated metal products.....	34	1,120	(D)	27	(D)	(D)	340	(D)
Machinery.....	35	(D)	1,530	(D)	1,833	665	(D)	(D)
Office, computing, and accounting machines.....	357	(D)	(D)	293	1,353	406	(D)	6,986
Other machinery, except electrical.....	351-56,358-59	2,960	(D)	(D)	480	259	397	(D)
Electrical equipment.....	36	16,920	1,526	261	1,261	609	3,220	10,042
Radio and TV receiving equipment.....	365	143	20	(D)	15	0	(D)	0
Communication equipment.....	366	9,538	(D)	85	461	(D)	1,507	6,891
Electronic components.....	367	(D)	796	(D)	(D)	(D)	854	(D)
Other electrical equipment.....	361-64,369	(D)	(D)	55	(D)	(D)	(D)	(D)
Transportation equipment.....	37	33,393	(D)	57	(D)	252	2,060	(D)
Motor vehicles and motor vehicles equipment.....	371	(D)	(D)	(D)	69	(D)	(D)	(D)
Other transportation equipment.....	373-75,379	(D)	17	(D)	23	(D)	(D)	0
Aircraft and missiles.....	372,376	23,506	(D)	(D)	(D)	(D)	(D)	21,916
Professional and scientific instruments.....	38	5,456	609	194	596	(D)	(D)	(D)
Scientific and mechanical measuring instruments...	381-82	(D)	(D)	85	(D)	51	(D)	(D)
Optical, surgical, photographic, and other instruments.....	383-87	(D)	(D)	109	(D)	(D)	(D)	(D)
Other manufacturing industries.....	27,31,39	(D)	18	(D)	(D)	93	117	0
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	8,743	3,789	574	1,833	(D)	337	(D)

(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-5. Companies' own and Federal funds for industrial R&D performance by industry, size of company, and size of R&D program: 1987

Industry and size of company	SIC code	Total	Size of R&D program (thousands of dollars)				
			Less than \$200	\$200 to \$999	\$1,000 to \$9,999	\$10,000 to \$99,999	\$100,000 or more
			[Millions of dollars]				
Total.....		\$96,305	\$958	\$2,316	\$8,038	\$13,286	\$71,707
Food, kindred, and tobacco products.....	20,21	1,402	3	23	140	689	546
Textiles and apparel.....	22,23	(D)	(D)	16	70	118	0
Lumber, wood products, and furniture.....	24,25	140	4	17	63	56	0
Paper and allied products.....	26	(D)	5	60	104	334	(D)
Chemicals and allied products.....	28	9,831	128	141	617	1,802	7,144
Industrial chemicals.....	281-82,286	3,879	19	0	123	843	2,896
Drugs and medicines.....	283	(D)	30	(D)	60	449	3,530
Other chemicals.....	284-85,287-89	(D)	80	(D)	434	510	718
Petroleum refining and extraction.....	13,29	1,899	3	3	38	315	1,539
Rubber products.....	30	(D)	21	33	150	324	(D)
Stone, clay, and glass products.....	32	1,024	(D)	19	139	236	(D)
Primary metals.....	33	(D)	(D)	17	169	358	(D)
Ferrous metals and products.....	331-32,3398-99	(D)	11	7	78	161	(D)
Nonferrous metals and products.....	333-36	452	(D)	10	92	197	(D)
Fabricated metal products.....	34	1,120	53	115	471	481	0
Machinery.....	35	(D)	102	271	1,162	2,615	(D)
Office, computing, and accounting machines.....	357	(D)	(D)	39	531	1,235	7,836
Other machinery, except electrical.....	351-56,358-59	2,960	(D)	232	631	1,381	(D)
Electrical equipment.....	36	16,920	148	310	1,542	1,769	13,152
Radio and TV receiving equipment.....	365	143	9	(D)	20	0	(D)
Communication equipment.....	366	9,538	37	64	424	678	8,335
Electronic components.....	367	(D)	37	(D)	741	716	2,654
Other electrical equipment.....	361-64,369	(D)	65	(D)	358	375	(D)
Transportation equipment.....	37	33,393	(D)	60	157	842	32,330
Motor vehicles and motor vehicles equipment.....	371	(D)	1	43	81	376	(D)
Other transportation equipment.....	373-75,379	(D)	2	13	31	(D)	(D)
Aircraft and missiles.....	372,376	23,506	(D)	4	45	(D)	23,138
Professional and scientific instruments.....	38	5,456	84	217	613	627	3,915
Scientific and mechanical measuring instruments....	381-82	(D)	33	114	310	326	(D)
Optical, surgical, photographic, and other instruments.....	383-87	(D)	51	104	303	301	(D)
Other manufacturing industries.....	27,31,39	(D)	(D)	14	134	232	0
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	8,743	349	1,000	2,469	2,486	2,439

Distribution by size of company
(based on number of employees)

Less than 500.....	8,844	908	2,031	4,853	1,052	0
500 to 999.....	1,979	32	136	770	1,041	0
1,000 to 4,999.....	8,078	15	128	1,739	4,960	1,236
5,000 to 9,999.....	5,130	1	12	388	1,984	2,745
10,000 to 24,999.....	12,423	(D)	(D)	258	3,173	8,986
25,000 or more.....	59,851	(D)	(D)	30	1,076	58,740

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of more than 50 percent.

(1) Less than \$0.5 million.

SOURCE: National Science Foundation, SRS

Table B-6. Number of companies with funds for research and development
by industry, size of company, and size of R&D program: 1987

Industry and size of company	SIC code	R&D size of program [thousands of dollars]					Total
		Less than \$200	\$200 to \$999	\$1,000 to \$9,999	\$10,000 to \$99,999	\$100,000 or more	
Total.....		25,833	17,094	5,361	2,785	470	123
Food, kindred, and tobacco products.....	20,21	149	33	48	38	27	3
Textiles and apparel.....	22,23	470	400	36	28	6	0
Lumber, wood products, and furniture.....	24,25	162	101	31	25	5	0
Paper and allied products.....	26	338	122	172	30	13	1
Chemicals and allied products.....	28	2,485	1,909	312	192	47	25
Industrial chemicals.....	281-82,286	260	204	0	29	20	7
Drugs and medicines.....	283	443	301	101	16	10	15
Other chemicals.....	284-85,287-89	1,782	1,404	211	147	17	3
Petroleum refining and extraction.....	13,29	135	104	6	9	9	7
Rubber products.....	30	497	382	60	40	13	2
Stone, clay, and glass products.....	32	187	106	41	31	7	2
Primary metals.....	33	273	168	39	47	17	2
Ferrous metals and products.....	331-32,3398-99	128	83	19	17	8	1
Nonferrous metals and products.....	333-36	145	85	20	30	9	1
Fabricated metal products.....	34	2,183	1,691	224	254	14	0
Machinery.....	35	3,009	1,822	608	469	96	14
Office, computing, and accounting machines.....	357	617	200	109	253	44	11
Other machinery, except electrical.....	351-56,358-59	2,392	1,622	499	216	52	3
Electrical equipment.....	36	3826	2,411	853	470	67	25
Radio and TV receiving equipment.....	365	195	161	27	6	0	1
Communication equipment.....	366	679	303	204	135	25	12
Electronic components.....	367	1,395	698	446	219	24	8
Other electrical equipment.....	361-64,369	1,557	1,249	176	110	18	4
Transportation equipment.....	37	285	37	152	49	25	22
Motor vehicles and motor vehicles equipment.....	371	165	7	117	27	10	4
Other transportation equipment.....	373-75,379	73	27	29	13	2	2
Aircraft and missiles.....	372,376	47	3	6	9	13	16
Professional and scientific instruments.....	38	1,959	1,208	538	179	24	10
Scientific and mechanical measuring instruments....	381-82	1,055	693	249	100	11	2
Optical, surgical, photographic, and other instruments.....	383-87	904	515	289	79	13	8
Other manufacturing industries.....	27,31,39	410	334	29	38	9	0
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	9,465	6,266	2,212	886	91	10
Distribution by size of company (based on number of employees)							
Less than 500.....		23,355	16,550	4,815	1,951	39	0
500 to 999.....		833	276	274	233	50	0
1,000 to 4,999.....		1,112	230	234	456	184	8
5,000 to 9,999.....		206	15	21	83	74	13
10,000 to 24,999.....		204	6	11	55	92	40
25,000 or more.....		123	17	6	7	31	62

SOURCE: National Science Foundation, SRS

Table B-7. Companies' own funds for industrial R&D performance by industry and size of company: 1957-58, 1963, 1967, 1972, and 1977-87

(Dollars in millions)																	
Industry and size of company	SIC code	1957	1958	1963	1967	1972	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total.....		83,396	83,630	95,360	98,020	911,535	619,340	622,115	625,708	636,476	635,428	640,476	645,037	652,731	658,480	661,725	664,902
Distribution by industry																	
Food, kindred, and tobacco products(1).....	20,21	74	77	(0)	181	258	(0)	(0)	(0)	(0)	636	817	881	1,234	1,315	1,535	1,400
Textiles and apparel.....	22,23	14	20	(0)	(0)	61	(0)	(0)	(0)	(0)	116	136	150	182	218	246	227
Wood, wood products, and furniture.....	24,25	14	12	(0)	12	(0)	123	126	139	148	161	164	174	189	182	188	140
Paper and allied products.....	26	35	42	69	(0)	(0)	(0)	(4)	(0)	495	566	566	552	594	576	538	611
Chemicals and allied products.....	28	616	666	1,004	1,297	1,741	2,907	3,250	3,692	4,264	5,205	6,197	6,792	7,736	8,310	8,656	9,638
Industrial chemicals.....	281-82,284	423	443	662	785	860	1,387	1,473	1,617	1,856	2,393	2,810	2,828	3,057	3,281	3,374	3,691
Drugs and medicines.....	283	104	126	207	(0)	(0)	(0)	(0)	(0)	1,756	2,064	2,473	2,896	3,310	3,481	3,654	4,088
Other chemicals.....	284-85,287-89	89	97	135	(0)	(0)	(0)	(0)	(0)	633	747	916	1,068	1,369	1,548	1,628	1,859
Petroleum refining and extraction.....	13,29	200	234	296	355	454	842	939	1,109	1,401	1,780	2,003	2,074	2,245	2,194	1,971	1,885
Gum, rubber, and plastic products.....	30	70	68	111	160	255	(0)	(0)	(0)	(0)	598	680	777	946	877	869	789
Stone, clay, and glass products.....	32	(0)	(0)	97	134	168	(0)	(0)	(0)	363	411	472	584	705	825	942	1,014
Primary metals.....	33	103	117	174	234	264	494	497	539	594	702	723	724	712	756	813	744
Nonferrous metals and products.....	331-32,3398-99	63	78	105	134	164	261	271	305	338	415	438	422	393	371	395	302
Other nonferrous metals and products.....	333-34	40	39	69	100	121	233	226	234	256	287	285	302	319	385	418	442
Fabricated metal products.....	34	97	105	129	151	243	342	348	414	501	545	578	697	954	968	1,021	1,034
Machinery.....	35	397	438	709	1,004	1,758	3,403	3,901	4,490	5,254	6,124	7,214	7,745	9,319	10,580	10,862	11,490
Office, computing, and accounting machines.....	357	(2)	(2)	(2)	(2)	(0)	2,220	2,556	2,958	3,436	3,847	4,054	5,476	6,704	7,939	7,894	8,496
Other machinery, except electrical.....	351-36,358-59	(3)	(3)	(3)	(3)	(3)	1,183	1,345	1,532	1,819	2,277	2,360	2,269	2,615	2,649	2,968	2,913
Electrical equipment.....	36	608	632	1,017	1,571	2,313	3,238	3,741	4,515	5,431	6,409	6,895	8,370	9,409	9,715	10,118	11,061
Radio and TV receiving equipment.....	365	(4)	(4)	(4)	(0)	(0)	85	102	192	346	338	364	326	362	350	133	143
Communication equipment.....	366				1,165	1,559	1,763	2,049	2,367	2,975	3,576	4,560	5,239	5,267	5,211	5,543	
Electronic components.....	367				205	(0)	(0)	(0)	(0)	1,165	1,212	1,341	1,806	2,346	2,814	3,340	3,641
Other electrical equipment.....	361-64,369	378	379	453	(0)	(0)	(0)	(0)	(0)	1,553	1,864	1,614	1,680	1,462	1,284	1,434	1,734
Transportation equipment.....	37	816	893	1,251	2,132	2,668	(0)	(0)	(0)	6,958	7,739	8,609	8,967	10,370	12,044	13,468	13,463
Motor vehicles and motor vehicles equipment.....	371				1,661	2,887	3,381	3,780	4,300	4,219	4,321	4,754	5,384	6,164	7,189	7,285	
Other transportation equipment.....	373-75,379	517	560	799	994	29	(0)	(0)	88	80	114	227	258	279	330	357	
Aircraft and missiles.....	372,376	299	333	452	1,138	978	1,547	1,823	2,201	2,570	3,440	4,174	3,986	4,728	5,601	5,949	5,841
Professional and scientific instruments.....	38	140	157	202	353	678	1,350	1,668	2,012	2,456	2,978	3,423	3,840	4,257	4,706	4,855	5,183
Scientific and mechanical measuring instruments.....	381-82	59	63	53	67	151	405	560	747	1,001	1,235	1,362	1,601	1,666	1,592	1,518	1,629
Optical, surgical, photographic, and other instruments.....	383-87	81	94	149	286	527	945	1,108	1,265	1,454	1,743	2,061	2,239	2,591	3,114	3,337	3,554
Other manufacturing industries.....	27,31,39	19	33	52	88	(0)	204	266	288	339	411	493	525	373	361	381	392
Nonmanufacturing industries.....	00,10-12,16-17, 40-47,72-73, 804-87,891	(0)	55	85	172	277	541	702	859	1,037	1,048	1,506	2,183	3,506	4,845	5,262	5,912
Distribution by size of company (based on number of employees)																	
Less than 500.....		375	299	425	459	603	1,145	1,226	1,375	1,711	1,880	2,574	3,978	4,329	5,720	6,943	7,448
500 to 999.....														1,376	1,569	1,813	1,806
1,000 to 4,999.....		406	440	596	666	843	1,289	1,586	1,893	2,257	2,586	3,298	3,507	4,022	5,470	6,518	7,023
5,000 to 9,999.....					642	890	1,439	1,310	1,463	1,596	2,369	2,337	2,217	3,170	3,789	4,003	4,391
10,000 to 24,999.....		2,615	2,891	4,338		1,540	2,583	3,203	4,012	4,867	5,537	6,442	7,221	8,524	8,342	8,459	10,667
25,000 or more.....					6,254	7,659	12,884	14,790	16,965	20,045	23,056	25,825	28,114	30,510	33,590	33,989	34,167

Notes: Company funds include all funds for industrial R&D work performed within company facilities from all sources (e.g., outside organizations such as research institutions, universities and colleges, other nonprofit organizations, and state governments, as well as companies' own funds) except funds provided by the Federal Government. Company-financed research and development contracted to outside organizations (except other companies) is excluded.

- (1) Data have been withheld to avoid disclosing operations of individual companies.
- (2) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."
- (3) Data not tabulated at this level prior to 1972.
- (4) Data not tabulated at this level prior to 1977.
- (5) Included in the other electrical equipment group.

SOURCE: National Science Foundation, SRS

Table B-8. Companies' own funds for industrial R&D performance
by industry and size of company: 1987

[Dollars in millions]

Industry	SIC code	Companies with total employment of--						
		Total	Less than 500	500 to 999	1,000 to 4,999	5,000 to 9,999	10,000 to 24,999	25,000 or more
Total.....		\$64,902	\$7,448	\$1,806	\$7,023	\$4,391	\$10,067	\$34,167
Food, kindred, and tobacco products.....	20,21	1,400	5	48	157	345	159	687
Textiles and apparel.....	22,23	227	17	24	58	8	52	68
Lumber, wood products, and furniture.....	24,25	140	3	(D)	63	14	48	(D)
Paper and allied products.....	26	611	49	12	86	61	294	110
Chemicals and allied products.....	28	9,638	556	(D)	1,213	(D)	3,703	3,061
Industrial chemicals.....	281-82,286	3,691	39	32	339	398	528	2,355
Drugs and medicines.....	283	4,088	66	(D)	484	(D)	2,629	(D)
Other chemicals.....	284-85,287-89	1,859	451	(D)	390	0	546	(D)
Petroleum refining and extraction.....	13,29	1,885	6	(D)	(D)	52	274	1,495
Rubber products.....	30	789	82	24	164	(D)	207	(D)
Stone, clay, and glass products.....	32	1,014	78	19	(D)	(D)	190	(D)
Primary metals.....	33	744	29	24	207	109	118	257
Ferrous metals and products.....	331-32,3398-99	302	12	14	61	(D)	41	(D)
Nonferrous metals and products.....	333-36	442	16	10	145	(D)	78	(D)
Fabricated metal products.....	34	1,034	479	(D)	88	84	279	(D)
Machinery.....	35	11,409	1,526	526	1,794	662	593	6,308
Office, computing, and accounting machines.....	357	8,496	408	293	1,335	406	(D)	(D)
Other machinery, except electrical.....	351-56,358-59	2,913	1,117	233	459	256	(D)	(D)
Electrical equipment.....	36	11,061	1,459	221	1,099	478	2,439	5,363
Radio and TV receiving equipment.....	365	143	20	(D)	15	0	(D)	0
Communication equipment.....	366	5,543	397	80	330	70	748	3,918
Electronic components.....	367	3,641	761	83	452	357	(D)	(D)
Other electrical equipment.....	361-64,369	1,734	282	(D)	302	51	753	(D)
Transportation equipment.....	37	13,463	52	(D)	182	164	872	(D)
Motor vehicles and motor vehicles equipment.....	371	7,265	(D)	19	69	80	283	(D)
Other transportation equipment.....	373-75,379	357	17	(D)	23	(D)	301	0
Aircraft and missiles.....	372,376	5,841	(D)	14	89	(D)	288	5,375
Professional and scientific instruments.....	38	5,183	604	192	584	344	400	3,058
Scientific and mechanical measuring instruments....	381-82	1,629	317	85	247	51	(D)	(D)
Optical, surgical, photographic, and other instruments.....	383-87	3,554	287	107	337	293	(D)	(D)
Other manufacturing industries.....	27,31,39	392	18	33	130	93	117	0
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	5,912	2,485	468	1,097	866	321	675

(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-9. Company-financed research and development contracted to outside organizations by industry and size of company: 1987

[Dollars in millions]

Industry	SIC code	1987
Total.....		\$2,584
Food, kindred, and tobacco products.....	20,21	20
Textiles and apparel.....	22,23	(D)
Lumber, wood products, and furniture.....	24,25	(D)
Paper and allied products.....	26	22
Chemicals and allied products.....	28	381
Industrial chemicals.....	281-82,286	61
Drugs and medicines.....	283	335
Other chemicals.....	284-85,287-89	185
Petroleum refining and extraction.....	13,29	72
Rubber products.....	30	23
Stone, clay, and glass products.....	32	69
Primary metals.....	33	21
Ferrous metals and products.....	331-32,3398-99	(D)
Nonferrous metals and products.....	333-36	(D)
Fabricated metal products.....	34	5
Machinery.....	35	117
Office, computing, and accounting machines.....	357	76
Other machinery, except electrical.....	351-56,358-59	41
Electrical equipment.....	36	198
Radio and TV receiving equipment.....	365	0
Communication equipment.....	366	71
Electronic components.....	367	(S)
Other electrical equipment.....	361-64,369	16
Transportation equipment.....	37	(D)
Motor vehicles and motor vehicles equipment.....	371	(D)
Other transportation equipment.....	373-75,379	17
Aircraft and missiles.....	372,376	293
Professional and scientific instruments.....	38	(D)
Scientific and mechanical measuring instruments....	381-82	8
Optical, surgical, photographic, and other instruments.....	383-87	(D)
Other manufacturing industries.....	27,31,39	(D)
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-87,891	606
Distribution by size of company (Based on number of employees)		
Less than 500.....		256
500 to 999.....		46
1,000 TO 4,999.....		327
5,000 TO 9,999.....		181
10,000 TO 24,999.....		616
25,000 or more.....		1,158

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of 50 percent or more.

SOURCE: National Science Foundation, SRS

Table B-10. Number of companies contracting research and development to outside organizations by industry and size of company: 1987

Industry	SIC code	Companies with total employment of--											
		Less than 500		500 to 999		1,000 to 4,999		5,000 to 9,999		10,000 to 24,999		25,000 or more	
		Total	Outside	Total	Outside	Total	Outside	Total	Outside	Total	Outside	Total	Outside
Total.....		23,355	3,387	833	148	1,112	319	206	53	204	66	123	47
Food, kindred, and tobacco products.....	20,21	8	2	39	8	55	15	17	2	15	4	15	6
Textiles and apparel.....	22,23	291	1	115	0	41	3	8	0	10	1	5	1
Lumber, wood products, and furniture.....	24,25	78	1	31	3	39	6	7	0	6	2	1	0
Paper and allied products.....	26	261	50	14	4	37	7	10	1	12	5	4	2
Chemicals and allied products.....	28	2,331	713	41	18	70	29	11	6	25	11	7	2
Industrial chemicals.....	281-82,286	209	102	9	5	24	9	6	2	7	3	5	1
Drugs and medicines.....	283	407	104	8	4	12	5	5	4	10	5	1	0
Other chemicals.....	284-85,287-89	1,715	507	24	9	34	15	0	0	8	3	1	1
Petroleum refining and extraction.....	13,29	103	0	4	2	12	3	5	0	4	4	7	5
Rubber products.....	30	298	13	46	20	136	106	9	4	7	1	1	1
Stone, clay, and glass products.....	32	112	23	28	1	31	6	5	1	8	3	3	2
Primary metals.....	33	178	14	27	3	45	15	12	5	7	2	4	2
Ferrous metals and products.....	331-32,3398-99	80	1	13	1	21	9	8	3	3	1	3	2
Nonferrous metals and products.....	333-36	98	13	14	2	24	6	4	2	4	1	1	0
Fabricated metal products.....	34	2,039	23	61	9	61	13	8	1	12	3	2	0
Machinery.....	35	2,721	479	109	21	139	15	24	6	9	1	7	5
Office, computing, and accounting machines.....	357	529	205	26	4	49	4	6	1	2	1	5	3
Other machinery, except electrical.....	351-56,358-59	2,192	274	83	17	90	11	18	5	7	0	2	2
Electrical equipment.....	36	3,557	756	91	22	126	21	15	1	24	5	13	9
Radio and TV receiving equipment.....	365	186	0	3	0	5	0	0	0	1	0	0	0
Communication equipment.....	366	618	156	14	4	27	3	5	0	8	2	7	3
Electronic components.....	367	1,307	353	33	7	42	5	4	0	6	2	3	1
Other electrical equipment.....	361-64,369	1,446	247	41	11	52	13	6	1	9	1	3	0
Transportation equipment.....	37	144	108	42	10	52	12	15	3	15	7	17	10
Motor vehicles and motor vehicles equipment.....	371	100	100	22	7	24	3	9	3	6	2	4	3
Other transportation equipment.....	373-75,379	42	8	12	3	14	5	2	0	3	2	0	0
Aircraft and missiles.....	372,376	2	0	8	0	14	4	4	0	6	3	13	7
Professional and scientific instruments.....	38	1,849	317	46	4	46	12	9	2	4	1	5	1
Scientific and mechanical measuring instruments.....	381-82	1,008	291	19	1	21	5	4	0	2	0	1	0
Optical, surgical, photographic, and other instruments.....	383-87	841	26	27	3	25	7	5	2	2	1	4	0
Other manufacturing industries.....	27,31,39	311	1	41	5	44	4	7	2	7	0	0	0
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	9,074	886	98	18	178	52	44	19	39	16	32	6

SOURCE: National Science Foundation, SRS

Table B-11. Company-financed research and development performed outside the United States by U.S. domestic companies and their foreign subsidiaries, by selected industry: 1974-87

Industry	SIC code	[Dollars in millions]													
		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total.....		\$1,300	\$1,454	\$1,659	\$1,877	\$2,209	\$2,754	\$3,165	\$3,393	\$3,094	\$3,269	\$3,633	\$3,650	\$4,651	\$5,021
Food, kindred, and tobacco products(1)...	20,21	27	23	29	32	43	51	54	62	64	63	70	75	69	36
Chemicals and allied products.....	28	208	269	312	332	395	500	603	715	682	729	786	843	1,071	1,265
Industrial and other chemicals.....	281-82,284-89	82	85	108	133	151	199	246	287	319	368	385	444	579	684
Drugs and medicines.....	283	126	184	204	199	244	301	357	428	363	361	401	399	492	581
Petroleum refining and extraction.....	13,29	(2)	(2)	(2)	(2)	(2)	(2)	141	194	133	103	101	47	40	47
Stone, clay, and glass products.....	32	7	7	(2)	(2)	(2)	(3)	21	18	10	19	60	(0)	(0)	(0)
Primary metals.....	33	3	9	12	9	9	11	11	9	9	10	9	(0)	(0)	1
Fabricated metal products.....	34	(2)	(2)	22	24	29	(3)	(3)	30	25	23	21	21	26	(0)
Machinery.....	35	258	331	352	411	460	534	599	612	494	577	740	689	951	1,196
Electrical equipment.....	36	238	245	278	300	352	445	451	475	467	482	537	591	(S)	407
Radio and TV receiving equipment.....	365	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(0)	(0)	0
Communication equipment.....	366														
Electronic components.....	367	4	7	9	13	17	25	29	40	38	(3)	92	117	150	199
Other electrical equipment.....	361-64,369	(3)	(3)	6	5	9	11	11	39	43	38	30	24	25	24
Transportation.....	37	406	412	464	558	640	874	1,020	884	843	880	907	1,025	(0)	(0)
Motor vehicles and other transportation equipment.....	371,373-75,379	364	373	423	514	(3)	(3)	(3)	(3)	(3)	(3)	(0)	(0)	(0)	(0)
Aircraft and missiles.....	372,376	42	39	41	44	(3)	(3)	(3)	(3)	(3)	(3)	(0)	(0)	182	130
Professional and scientific instruments..	38	39	49	69	81	121	156	186	230	237	(3)	263	169	212	292
Other manufacturing industries.....	22-27,30-31,39	111	105	137	144	181	213	139	156	123	92	131	125	168	161
Nonmanufacturing industries.....	08,10-12,14-17,40-47,72-73,806-07,891	3	4	4	9	12	5	7	8	7	10	8	18	27	35

Note: Data are reported in current U.S. dollars.

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of more than 50 percent.

(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

(2) Included in the other manufacturing industries group.

(3) Not separately available but included in total. See general notes.

SOURCE: National Science Foundation, SRS

Table B-12. Companies' own funds for R&D performance by selected industry: 1987 actual and 1988 projected

		[Dollars in millions]	
Industry	SIC code	Actual 1987	1988 (projected)
Total.....		\$64,902	(S)
Chemicals and allied products.....	28	9,638	10,581
Industrial chemicals.....	281-82,286	3,691	3,772
Machinery.....	35	11,409	12,863
Electrical equipment.....	36	11,061	12,892
Communication equipment.....	366	5,543	(S)
Motor vehicles and motor vehicles equipment.....	371	7,265	(S)
Aircraft and missiles.....	372,376	5,841	4,773
All other industries.....		19,688	22,055

(S) Data have been withheld due to imputation of more than 50 percent.

SOURCE: National Science Foundation, SRS

Table B-13. Federal funds for industrial R&D performance by industry and size of company: 1957-58, 1963, 1967, 1972, and 1977-87

[Dollars in millions]

Industry and size of company	SIC code	1957	1958	1963	1967	1972	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total.....		84,335	84,759	87,270	88,365	88,017	810,485	811,189	812,518	814,029	816,382	818,534	820,657	823,356	827,130	828,171	831,403
Distribution by industry																	
Food, kindred, and tobacco products(1).....	20,21	0	6	(D)	2	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	2
Textiles and apparel.....	22,23	(D)	(D)	(D)	(D)	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Lumber, wood products, and furniture.....	24,25	(D)	(D)	(D)	0	(D)	0	0	0	(D)	0	0	0	0	0	0	0
Paper and allied products.....	26	0	0	0	(D)	2	(D)	(D)	(D)	(D)	(D)	0	(D)	(D)	(D)	(D)	(D)
Chemicals and allied products.....	28	89	126	234	210	189	295	330	346	372	421	407	393	191	230	181	193
Industrial chemicals.....	281-82,286	80	110	146	181	171	281	325	345	341	409	396	386	183	217	179	188
Drugs and medicines.....	283	0	2	9	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	1	(D)
Other chemicals.....	284-85,287-89	9	14	79	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	0	(D)
Petroleum refining and extraction.....	13,29	11	12	21	16	15	76	121	153	151	(D)	(D)	(D)	(D)	(D)	(D)	14
Rubber products.....	30	37	21	46	22	123	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Stone, clay, and glass products.....	32	(D)	(D)	3	2	14	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	9	10
Primary metals.....	33	5	14	10	0	12	44	63	95	135	176	276	384	(D)	(D)	(D)	(D)
Ferrous metals and products.....	331-32,3398-99	1	2	2	1	3	23	43	70	105	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Nonferrous metals and products.....	333-36	4	12	0	6	10	21	20	25	30	(D)	(D)	(D)	10	9	5	10
Fabricated metal products.....	34	38	57	24	13	12	44	36	41	49	80	60	67	69	49	95	86
Machinery.....	35	272	343	250	322	401	477	382	335	647	694	851	1,116	1,192	1,495	(D)	(D)
Office, computing, and accounting machines.....	357	(2)	(2)	(2)	(2)	(D)	435	327	256	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other machinery, except electrical.....	351-56,358-59	(3)	(3)	(3)	(3)	(3)	42	55	79	(D)	(D)	(D)	(D)	(D)	(D)	75	47
Electrical equipment.....	36	1,196	1,337	1,849	2,296	2,367	2,648	2,766	3,309	3,744	3,920	4,323	4,684	4,968	5,521	5,594	5,859
Radio and TV receiving equipment.....	365	(4)	(4)	(4)	(D)	(D)	11	28	53	210	(D)	(D)	(D)	(D)	(D)	0	0
Communication equipment.....	366	518	615	1,209	1,495	1,417	1,166	1,236	1,586	1,657	1,783	2,182	2,573	3,115	3,595	3,812	3,995
Electronic components.....	367	678	722	640	(D)	125	(D)	(D)	(D)	382	361	398	359	477	559	(D)	(D)
Other electrical equipment.....	361-64,369	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	1,495	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Transportation equipment.....	37	2,465	2,572	4,552	4,891	4,302	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	16,954	19,930
Motor vehicles and motor vehicles equipment.....	371	190	296	291	360	293	471	498	729	653	587	476	564	673	820	(D)	(D)
Other transportation equipment.....	373-75,379	2,275	2,276	4,261	4,531	3,970	5,486	5,713	5,840	6,628	8,528	10,098	11,103	13,478	15,628	14,230	17,665
Aircraft and missiles.....	372,376	2,275	2,276	4,261	4,531	3,970	5,486	5,713	5,840	6,628	8,528	10,098	11,103	13,478	15,628	14,230	17,665
Professional and scientific instruments.....	38	109	137	81	189	161	221	330	493	573	637	523	450	391	391	352	273
Scientific and mechanical measuring instruments...	381-82	80	93	16	37	13	47	110	203	350	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Optical, surgical, photographic, and other instruments.....	383-87	29	44	65	152	148	174	220	290	223	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other manufacturing industries.....	27,31,39	74	72	3	(D)	(D)	39	0	0	25	(D)	(D)	(D)	(D)	(D)	2	(D)
Nonmanufacturing industries.....	80,10-12,14-17, 40-67,72-73, 806-07,891	0	62	190	387	431	417	527	681	779	858	995	1,238	1,619	2,242	2,608	2,831
Distribution by size of company (based on number of employees)																	
Less than 500.....		167	233	194	228	326	208	212	389	354	424	582	798	780	951	1,196	1,396
500 to 999.....		226	202	425	351	372	237	345	590	444	562	602	677	776	816	925	1,056
1,000 to 4,999.....		3,942	4,324	6,651	251	186	390	241	228	432	619	485	755	406	621	768	738
5,000 to 24,999.....						619	835	1,075	1,179	1,150	1,225	1,384	1,810	2,072	2,028	1,696	2,356
25,000 or more.....					7,536	6,514	8,815	9,316	10,132	11,648	13,551	15,481	16,617	19,133	22,435	23,268	25,684

(D) Data have been withheld to avoid disclosing operations of individual companies.

1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

2) Data not tabulated at this level prior to 1972.

3) Data not tabulated at this level prior to 1977.

4) Included in the other electrical equipment group.

SOURCE: National Science Foundation, SRS

Table B-14. Federal funds for industrial R&D performance
by industry and size of company: 1987

		[Dollars in millions]						
		Companies with total employment of--						
Industry	SIC code	Total	Less than 500	500 to 999	1,000 to 4,999	5,000 to 9,999	10,000 to 24,999	25,000 or more
Total.....		\$31,403	\$1,396	\$173	\$1,056	\$738	\$2,356	\$25,684
Food, kindred, and tobacco products.....	20,21	2	0	0	0	(D)	(D)	(D)
Textiles and apparel.....	22,23	(D)	(D)	(D)	0	0	0	0
Lumber, wood products, and furniture.....	24,25	0	0	0	0	0	0	0
Paper and allied products.....	26	(D)	0	0	0	0	0	(D)
Chemicals and allied products.....	28	193	(D)	(D)	9	7	(D)	(D)
Industrial chemicals.....	281-82,286	188	0	(D)	(D)	7	(D)	(D)
Drugs and medicines.....	283	(D)	(D)	0	(D)	0	2	0
Other chemicals.....	284-85,287-89	(D)	0	(D)	0	0	0	0
Petroleum refining and extraction.....	13,29	14	0	0	(D)	(D)	(D)	(D)
Rubber products.....	30	(D)	(D)	0	(D)	(D)	(D)	(D)
Stone, clay, and glass products.....	32	10	0	0	(D)	0	2	(D)
Primary metals.....	33	(D)	(D)	(D)	1	(D)	(D)	(D)
Ferrous metals and products.....	331-32,3398-99	(D)	0	(D)	(D)	(D)	0	(D)
Nonferrous metals and products.....	333-36	10	(D)	0	(D)	(D)	(D)	(D)
Fabricated metal products.....	34	86	(D)	(D)	(D)	(D)	61	0
Machinery.....	35	(D)	4	(D)	38	3	(D)	(D)
Office, computing, and accounting machines.....	357	(D)	(D)	0	17	0	0	(D)
Other machinery, except electrical.....	351-56,358-59	47	(D)	(D)	21	3	(D)	(D)
Electrical equipment.....	36	5,859	67	40	162	131	781	4,679
Radio and TV receiving equipment.....	365	0	0	0	0	0	0	0
Communication equipment.....	366	3,995	(D)	5	131	(D)	759	2,972
Electronic components.....	367	(D)	35	(D)	(D)	(D)	(D)	(D)
Other electrical equipment.....	361-64,369	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Transportation equipment.....	37	19,930	(D)	(D)	(D)	87	1,188	(D)
Motor vehicles and motor vehicles equipment.....	371	(D)	0	(D)	0	(D)	(D)	(D)
Other transportation equipment.....	373-75,379	(D)	0	0	0	(D)	(D)	0
Aircraft and missiles.....	372,376	17,665	(D)	(D)	(D)	26	(D)	16,541
Professional and scientific instruments.....	38	273	5	2	12	(D)	(D)	(D)
Scientific and mechanical measuring instruments...	381-82	(D)	(D)	0	(D)	0	(D)	(D)
Optical, surgical, photographic, and other instruments.....	383-87	(D)	(D)	2	(D)	(D)	(D)	(D)
Other manufacturing industries.....	27,31,39	(D)	0	(D)	(D)	0	0	0
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	2,831	1,304	106	736	(D)	16	(D)

(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-15. Federal funds for industrial R&D performance by selected industry and agency: 1963-65, 1967-77, 1979, 1981, 1983, 1985, and 1987

Industry	SIC CODE	[Dollars in millions]																		
		1963	1964	1965	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1979	1981	1983	1985	1987
DOD(2)																				
Total.....		\$7,270	\$7,720	\$7,740	\$8,365	\$8,560	\$8,451	\$7,779	\$7,666	\$8,017	\$8,145	\$8,220	\$8,605	\$9,561	\$10,485	\$12,518	\$16,382	\$20,657	\$27,130	\$31,403
Chemicals and allied products.....	28	234	202	191	210	199	192	180	184	189	203	214	236	266	295	346	421	393	230	193
Machinery.....	35	250	246	239	322	340	260	282	315	401	429	511	509	532	477	335	694	1,116	1,495	(D)
Electrical equipment.....	36	1,849	1,873	1,983	2,296	2,333	2,390	2,211	2,258	2,367	2,410	2,307	2,307	2,555	2,648	3,309	3,920	4,684	5,521	5,859
Motor vehicles and other transportation equipment.....	371,373-75,379	291	322	325	360	374	290	314	309	319	424	335	365	(1)	(1)	(1)	(1)	(1)	(1)	820
Aircraft and missiles.....	372,376	4,261	4,621	4,499	4,531	4,533	4,524	4,005	3,864	3,970	3,889	4,003	4,434	4,930	5,486	5,840	8,528	11,103	15,828	17,668
Other industries.....	--	385	456	503	646	781	795	807	736	771	790	850	754	(1)	(1)	(1)	(1)	(1)	(1)	3,436
DOD(2)																				
Total.....		\$4,700	\$4,192	\$3,808	\$5,144	\$5,427	\$5,688	\$5,288	\$5,315	\$5,818	\$6,088	\$5,919	\$5,812	\$6,222	\$6,950	\$7,939	\$10,540	\$14,587	\$20,997	21,800
Chemicals and allied products.....	28	(1)	104	63	64	64	49	35	40	40	48	39	27	28	32	36	40	48	(S)	(D)
Machinery.....	35	148	132	147	228	192	182	186	201	250	302	426	405	442	395	541	599	963	1,287	(D)
Electrical equipment.....	36	1,200	1,720	1,130	1,437	1,517	1,584	1,484	1,503	1,663	1,770	1,643	1,570	1,607	1,692	1,920	2,338	3,166	4,078	(S)
Motor vehicles and other transportation equipment.....	371,373-75,379	(1)	194	221	261	270	242	272	246	232	325	251	288	337	382	(1)	(1)	(1)	(1)	(D)
Aircraft and missiles.....	372,376	2,700	2,389	2,006	2,745	2,811	3,050	2,771	2,848	3,084	3,077	2,992	3,120	3,408	3,900	4,210	6,121	8,659	13,117	13,084
Other Industries.....	--	(1)	253	241	409	573	581	540	477	549	566	568	402	400	461	(1)	(1)	(1)	(1)	2,741
NASA(2)																				
Total.....		\$1,800	\$2,725	\$3,166	\$2,300	\$2,311	\$1,868	\$1,421	\$1,391	\$1,111	\$982	\$1,095	\$1,409	\$1,604	\$1,697	\$1,786	\$2,306	\$2,152	(S)	2,748
Chemicals and allied products.....	28	(1)	2	1	2	5	5	1	3	1	1	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(S)	(D)
Machinery.....	35	(1)	91	101	79	99	79	78	79	81	78	63	62	62	54	74	81	(1)	(D)	(D)
Electricals equipment.....	36	300	264	468	404	423	336	274	298	222	181	162	186	200	208	252	317	195	96	125
Motor vehicles and other transportation Equipment.....	371,373-75,379	(1)	120	98	87	82	33	33	48	58	45	25	27	(1)	(1)	(1)	(1)	(1)	(S)	(D)
Aircraft and missiles.....	372,376	1,400	2,084	2,340	1,595	1,555	1,285	949	898	694	617	789	1,082	1,267	1,348	1,221	1,765	1,909	(S)	2,528
Other Industries.....	--	(1)	165	163	133	147	132	87	65	55	60	(1)	(1)	45	44	119	70	(1)	(D)	52
DOE																				
Total.....		(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	\$1,976	\$1,951	\$2,908	2,908
Chemicals and allied products.....	28	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(1)	(1)	(1)	(S)
Machinery.....	35	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(1)	(1)	(1)	(S)
Electricals equipment.....	36	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(1)	(1)	(1)	(S)
Motor vehicles and other transportation Equipment.....	371,373-75,379	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	784	951	950	1,271
Aircraft and missiles.....	372,376	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	16	20	28	(S)
Other Industries.....	--	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	340	202	441	656
																	287	356	281	575

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of 50 percent or more.

(1) Not separately available but included in total. See general notes.

(2) For 1963-74, funds were based on data from approximately 175 companies leading in Federal R&D funds; 1975-87 funds are based on data from all companies reporting Federal R&D funds.

(3) Data not tabulated for this agency prior to 1979.

SOURCE: National Science Foundation, SRS

Table B-16. Number of R&D-performing companies reporting Federal R&D funds by industry and size of company: 1987

Industry	SIC code	Companies with total employment of--											
		Less than 500		500 to 999		1,000 to 4,999		5,000 to 9,999		10,000 to 24,999		25,000 or more	
		Total	Federal	Total	Federal	Total	Federal	Total	Federal	Total	Federal	Total	Federal
Total.....		23,355	1,449	833	35	1,112	70	206	33	204	54	123	5
Food, kindred, and tobacco products...	20,21	8	0	39	0	55	0	17	1	15	1	15	1
Textiles and apparel.....	22,23	291	1	115	1	41	0	8	0	10	0	5	0
Lumber, wood products, and furniture...	24,25	78	0	31	0	39	0	7	0	6	0	1	0
Paper and allied products.....	26	261	0	14	0	37	0	10	0	12	0	4	0
Chemicals and allied products.....	28	2,331	100	41	2	70	5	11	4	25	5	7	0
Industrial chemicals.....	281-82,286	209	0	9	1	24	3	6	4	7	2	5	0
Drugs and medicines.....	283	407	100	8	0	12	2	5	0	10	3	1	0
Other chemicals.....	284-85,287-89	1,715	0	24	1	34	0	0	0	8	0	1	0
Petroleum refining and extraction.....	13,29	103	0	4	0	12	1	5	1	4	2	7	0
Rubber products.....	30	298	1	46	0	136	1	9	2	7	2	1	0
Stone, clay, and glass products.....	32	112	0	28	0	31	1	5	0	8	3	3	0
Primary metals.....	33	178	2	27	1	45	5	12	2	7	2	4	0
Ferrous metals and products.....	331-32,3398-99	80	0	13	1	21	1	8	1	3	0	3	0
Nonferrous metals and products.....	333-36	98	2	14	0	24	4	4	1	4	2	1	0
Fabricated metal products.....	34	2,039	1	61	1	61	1	8	2	12	4	2	0
Machinery.....	35	2,721	63	109	1	139	10	24	4	9	1	7	0
Office, computing, and accounting machines.....	357	529	2	26	0	49	4	6	0	2	0	5	0
Other machinery, except electrical...	351-56,358-59	2,192	61	83	1	90	6	18	4	7	1	2	0
Electrical equipment.....	36	3,557	159	91	8	126	17	15	5	24	12	13	0
Radio and TV receiving equipment.....	365	186	0	3	0	5	0	0	0	1	0	0	0
Communication equipment.....	366	618	45	14	3	27	9	5	3	8	6	7	0
Electronic components.....	367	1,307	111	33	3	42	5	4	1	6	4	3	0
Other electrical equipment.....	361-64,369	1,446	3	41	2	52	3	6	1	9	2	3	0
Transportation equipment.....	37	144	1	42	3	52	6	15	5	15	9	17	0
Motor vehicles and motor vehicles equipment.....	371	100	0	22	1	24	0	9	1	6	2	4	0
Other transportation equipment.....	373-75,379	42	0	12	0	14	0	2	1	3	2	0	0
Aircraft and missiles.....	372,376	2	1	8	2	14	6	4	3	6	5	13	1
Professional and scientific instruments	38	1,849	24	46	3	46	5	9	1	4	2	5	0
Scientific and mechanical measuring instruments.....	381-82	1,008	23	19	0	21	2	4	0	2	1	1	0
Optical, surgical, photographic, and other instruments.....	383-87	841	1	27	3	25	3	5	1	2	1	4	0
Other manufacturing industries.....	27,31,39	311	0	41	2	44	1	7	0	7	0	0	0
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	9,074	1,097	98	13	178	17	44	6	39	11	32	0

SOURCE: National Science Foundation, SRS

Table B-17. Industry-administered federally funded research and development centers--
--composition of workforce and funds
by character of work: 1986-87

Item	1986	1987
Total R&D funds(1).....	\$2,267	\$2,351
Basic research.....	124	142
Applied research.....	679	706
Development.....	1,465	1,504
Full-time-equivalent number of R&D scientists and engineers		
	January 1987	January 1988
	10,453	11,624
March 1987		
	31,152	39,546
Total employment.....		

(1) All of these funds were devoted to Federal R&D activities.

SOURCE: National Science Foundation, SMS

Table B-18. Number of R&D-performing companies in manufacturing and nonmanufacturing industries by size of company: 1987

Size of company (based on number of employees)	Number of companies reporting R&D funds		
	Total	Manu- facturing	Nonmanu- facturing
Total.....	25,833	16,366	9,467
Less than 500.....	23,355	14,280	9,075
500 to 999.....	833	735	98
1,000 to 4,999.....	1112	934	178
5,000 to 9,999.....	206	162	44
10,000 to 24,999.....	204	165	39
25,000 or more.....	123	90	33

SOURCE: National Science Foundation, SRS

Table B-19. Percent of total, Federal, and company funds, and net sales of R&D-performing companies ranked by size of R&D program: 1972, 1974-87

Companies ranked by size of R&D program(1)	1972	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Percent of total R&D funds ranked by size of total R&D funds															
First 4 (1-4).....	18	20	20	20	20	19	20	17	18	20	19	17	18	19	19
Next 4 (5-8).....	16	15	15	14	14	14	13	14	12	12	11	13	12	11	11
Next 12 (9-20).....	21	21	19	20	19	19	19	18	20	19	17	17	17	14	14
Next 20 (21-40).....	12	11	12	12	13	13	13	13	12	13	13	13	13	13	13
Next 60 (41-100).....	13	15	15	15	15	15	15	15	18	16	17	18	16	15	15
Next 100 (101-200).....	7	8	8	8	9	9	9	9	9	9	9	9	9	10	10
Next 200 (201-400).....	6	6	6	6	6	6	6	6	6	6	6	6	5	8	8
Percent of Federal R&D funds ranked by size of Federal funds															
First 4 (1-4).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	30	29	30	30
Next 4 (5-8).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	15	15	16	16
Next 12 (9-20).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	26	27	28	28
Next 20 (21-40).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	17	16	15	15
Next 60 (41-100).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	10	7	7	7
Next 100 (101-200).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	1	2	2	2
Next 200 (201-400).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	0	0	1	1
Percent of company R&D funds ranked by company R&D funds															
First 4 (1-4).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	22	23	20	20
Next 4 (5-8).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	8	7	7	7
Next 12 (9-20).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	12	12	12	12
Next 20 (21-40).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	12	12	10	10
Next 60 (41-100).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	18	18	16	16
Next 100 (101-200).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	11	10	10	10
Next 200 (201-400).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	7	7	8	8
Percent of net sales ranked by size of total R&D funds															
First 4 (1-4).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	7	8	8	8
Next 4 (5-8).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	4	4	5	5
Next 12 (9-20).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	5	5	5	5
Next 20 (21-40).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	8	8	7	7
Next 60 (41-100).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	12	12	10	10
Next 100 (101-200).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	13	13	10	10
Next 200 (201-400).....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	14	15	9	9

(1) Companies were ranked individually for each year; therefore, particular companies comprising the size groups may have changed from year to year.
(2) Data not available.

Table B-20. Domestic net sales of R&D-performing companies by industry and size of company: 1986-87

Industry	SIC code	[Dollars in millions]									
		1986					1987				
		Companies with total employment of--					Companies with total employment of--				
		Less than 500	500 to 999	1,000 to 4,999	5,000 to 9,999	10,000 to 24,999	25,000 or more	Less than 500	500 to 999	1,000 to 4,999	5,000 to 24,999
Total		Total						Total			
Total.....		\$2,125,721	\$127,259	\$460,398	\$286,310	\$210,230	\$415,121	\$1,026,403	\$2,253,808	\$142,813	\$67,795
Food, kindred, and tobacco products.....	20-21	209,019	415	4,634	28,207	22,101	38,810	114,852	213,791	384	4,672
Textiles and apparel.....	22-23	49,201	6,291	5,872	8,876	4,000	6,290	19,872	54,919	6,875	7,157
Leather, wood products, and furniture.....	24-25	22,451	(D)	2,060	8,536	2,341	6,349	(D)	25,237	2,180	3,483
Paper and allied products.....	26	74,487	4,024	1,507	9,632	7,055	34,026	18,243	86,845	3,948	8,779
Chemicals and allied products.....	28	169,353	10,978	5,024	27,345	13,928	54,467	57,811	185,697	12,394	10,529
Industrial chemicals.....	281-82,286	76,645	1,150	1,502	7,149	8,483	17,051	41,310	80,935	1,342	8,913
Drugs and medicines.....	283	43,290	(S)	786	5,988	(D)	25,297	(D)	48,188	(D)	969
Other chemicals.....	284-85,287-89	49,618	7,724	2,736	14,208	(D)	12,119	(D)	56,574	(D)	5,960
Petroleum refining and extraction.....	13-29	182,523	586	464	10,712	16,008	23,331	131,412	182,068	473	1,051
Rubber products.....	30	39,013	(D)	2,356	7,813	6,499	10,330	(D)	43,121	4,976	6,407
Stone, clay, and glass products.....	32	38,462	1,268	2,019	6,708	5,901	7,241	15,525	39,014	1,200	8,403
Primary metals.....	33	79,398	1,837	2,364	13,402	14,775	17,289	29,731	88,264	2,556	7,919
Ferrous metals and products.....	331-32,3398-99	49,964	(D)	899	5,736	6,937	10,066	(D)	51,066	(D)	2,432
Nonferrous metals and products.....	333-36	29,434	(D)	1,465	7,666	7,838	7,223	(D)	37,198	(D)	15,530
Fabricated metal products.....	34	58,048	(D)	3,236	12,316	9,047	15,426	(D)	66,719	14,854	6,407
Machinery.....	35	146,230	23,328	8,014	33,524	13,827	16,673	50,864	149,609	23,106	9,123
Office, computing, and accounting machines.....	357	67,336	(D)	2,084	13,558	2,201	5,113	(D)	67,443	3,025	12,867
Other machinery, except electrical.....	351-56,358-59	78,894	(D)	5,930	19,966	11,626	11,560	(D)	82,166	20,081	36,989
Electrical equipment.....	36	190,158	15,443	4,942	20,877	10,496	37,332	100,868	206,574	18,777	16,853
Radio and TV receiving equipment.....	365	3,704	606	(D)	1,233	0	(D)	0	4,413	569	5,312
Communication equipment.....	366	97,939	3,244	(D)	5,483	4,780	(D)	73,781	102,418	4,353	23,798
Electronic components.....	367	36,341	5,453	1,541	5,454	2,599	7,236	14,058	41,907	6,990	1,380
Other electrical equipment.....	361-64,369	52,175	6,340	2,341	8,707	(S)	18,641	13,029	57,836	6,865	5,937
Transportation equipment.....	37	377,817	5,030	2,800	14,912	22,026	27,138	305,911	391,803	5,373	5,289
Motor vehicles and motor vehicles equipment.....	371	214,954	(D)	1,818	9,661	(D)	9,337	173,936	220,076	(D)	6,610
Other transportation equipment.....	373-75,379	12,249	(D)	507	2,707	(D)	6,260	0	14,584	(D)	2,990
Aircraft and missiles.....	372,376	150,714	(D)	475	2,544	(D)	11,541	131,975	157,143	(D)	13,863
Professional and scientific instruments.....	38	58,286	6,331	2,909	8,419	5,336	5,616	29,675	62,140	7,471	16,024
Scientific and mechanical measuring instruments... Optical, surgical, photographic, and other instruments.....	381-82 383-87	18,116	3,305	970	3,516	1,561	(D)	20,153	3,871	1,127	8,959
Other manufacturing industries.....	27,31,39	32,061	(D)	2,785	11,083	2,806	10,525	(D)	35,295	(D)	3,588
Nonmanufacturing industries.....	08,10-12,16-17, 40-47,72-73, 806-07,891	398,814	28,341	9,412	65,948	54,082	104,281	136,750	422,712	35,947	5,371

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.

Table B-21. Companies' own and Federal R&D funds as a percent of net sales in R&D-performing manufacturing companies by industry and size of company: 1957-58, 1963, 1967, 1972, and 1974-87

		[Percent]																		
Industry and size of company	SIC code	1957	1958	1963	1967	1972	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total.....		3.4	3.0	4.5	4.2	3.4	3.1	3.1	3.1	2.9	2.9	2.6	3.0	3.1	3.0	3.9	3.9	4.4	4.7	4.8
Distribution by Industry																				
Food, kindred, and tobacco products(1).....	20,21	0.3	0.3	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	(B)	(B)	(B)	(B)	(B)	(B)	0.7
Textiles and apparel.....	22,23	(2)	0.3	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Lumber, wood products, and furniture.....	24,25	(2)	0.4	0.5	0.3	0.8	0.8	0.7	0.7	0.8	0.7	0.7	0.8	0.8	1.0	1.0	0.9	1.0	0.8	0.6
Paper and allied products.....	26	0.6	0.7	0.8	0.9	0.8	0.8	0.9	1.0	0.9	0.9	1.0	1.0	(B)	1.1	(B)	(B)	(B)	(B)	(B)
Chemicals and allied products.....	28	3.5	3.0	4.3	4.6	3.6	3.5	3.7	3.7	3.6	3.6	3.5	3.6	3.6	4.3	4.4	4.7	5.0	5.2	5.3
Industrial chemicals.....	281-82,286	5.0	5.4	5.1	4.0	3.9	3.3	3.6	3.7	3.5	3.5	3.2	3.3	3.2	4.0	3.9	4.0	4.4	4.6	4.8
Drugs and medicines.....	283	3.6	4.1	4.7	6.1	6.5	6.3	6.4	6.3	6.4	6.2	6.1	6.2	(B)	(B)	(B)	(B)	(B)	0.5	(B)
Other chemicals.....	284-85,287-89	1.3	1.5	2.8	2.3	1.7	1.6	1.7	1.7	1.8	1.8	1.8	1.9	(B)	(B)	(B)	(B)	(B)	3.3	(B)
Petroleum refining and extraction.....	13,29	0.7	1.1	1.0	0.8	0.8	0.6	0.7	0.6	0.7	0.7	0.7	0.6	(B)	(B)	(B)	(B)	(B)	(B)	1.0
Rubber products.....	30	1.7	1.0	2.3	1.9	2.6	2.5	2.5	2.4	2.1	1.9	1.9	2.2	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Stone, clay, and glass products.....	32	(3)	1.6	1.0	1.7	1.7	1.2	1.2	1.3	1.3	1.3	1.4	1.4	(B)	(B)	(B)	(B)	(B)	2.5	2.6
Primary metals.....	33	0.5	0.7	0.8	0.8	0.7	0.6	0.8	0.8	0.7	0.7	0.6	0.7	0.9	1.1	1.3	(B)	(B)	(B)	(B)
Ferrous metals and products.....	331-32,3398-99	(2)	0.6	0.7	0.8	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.7	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Nonferrous metals and products.....	333-36	(2)	0.7	1.1	1.0	0.9	1.0	1.2	1.2	1.0	0.8	0.7	0.7	(B)	(B)	(B)	1.2	1.3	1.4	1.2
Fabricated metal products.....	34	1.6	1.7	1.6	1.3	1.1	1.2	1.2	1.2	1.2	1.1	1.1	1.4	1.4	1.4	1.7	1.9	1.9	1.9	1.7
Machinery.....	35	3.4	3.8	4.2	4.2	4.3	4.6	4.8	4.9	4.9	4.6	4.5	5.0	4.9	5.6	6.2	6.4	7.6	(B)	(B)
Office, computing, and accounting machines.....	357	(4)	(4)	(4)	(4)	11.1	12.6	12.0	11.6	11.5	11.1	11.0	12.0	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Other machinery, except electrical.....	351-56,358-59	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	2.2	2.1	2.1	2.3	(B)	(B)	(B)	(B)	(B)	3.9	3.6
Electrical equipment.....	36	7.6	10.3	10.1	8.6	7.1	6.6	6.5	6.7	6.9	5.8	6.0	6.6	6.8	7.6	8.3	7.2	8.0	8.3	8.2
Radio and TV receiving equipment.....	365	(6)	(6)	(6)	1.9	1.6	1.7	1.4	1.4	1.8	1.8	2.5	4.3	(B)	(B)	(B)	(B)	(B)	3.6	3.2
Communication equipment.....	366	(2)	11.3	13.0	10.3	8.7	7.6	7.6	7.7	7.7	8.8	9.1	9.6	11.0	11.5	8.3	9.3	9.2	9.3	
Electronic components.....	367					5.9	6.2	6.9	7.3	6.8	6.7	7.1	7.9	7.4	6.8	7.7	7.8	9.6	(B)	(B)
Other electrical equipment.....	361-64,369	(2)	9.7	7.3	7.3	6.3	6.3	6.0	6.3	5.2	5.1	4.9	4.9	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Transportation equipment.....	37															(B)	(B)	8.1	8.5	
Motor vehicles and motor vehicles equipment.....	371					3.3	3.7	3.5	3.2	3.1	3.3	3.0	4.9	4.5	4.5	4.0	3.4	3.8	(B)	(B)
Other transportation equipment.....	373-75,379	2.9	4.2	3.4	3.4	1.0	1.3	1.3	1.3	1.2	0.8	0.8	0.6	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Aircraft and missiles.....	372,376	16.8	17.7	26.7	19.7	16.6	14.1	12.7	12.7	13.3	13.3	12.9	13.7	16.0	17.1	15.2	15.4	14.9	13.4	15.0
Professional and scientific instruments.....	38	7.0	7.8	5.9	5.4	5.9	6.1	5.9	6.2	6.3	6.9	7.3	7.5	8.1	8.6	8.8	8.5	9.1	9.0	8.8
Scientific and mechanical measuring instruments...	381-82	9.5	10.2	4.1	3.9	4.1	4.5	4.9	5.4	6.3	7.1	7.3	8.4	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Optical, surgical, photographic, and other instruments.....	383-87	5.2	6.3	6.9	6.0	6.6	6.7	6.3	6.4	6.4	6.8	7.2	6.9	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Other manufacturing industries.....	27,31,39	(2)	1.3	0.7	0.6	0.8	0.9	0.8	0.7	0.6	0.5	0.4	0.4	(B)	(B)	(B)	(B)	(B)	1.2	(B)
Distribution by size of company (based on number of employees)																				
Less than 500.....		1.8	1.3	1.9	1.7	1.7	1.8	1.6	1.7	1.5	1.6	1.6	1.4	1.5	2.3	2.1	2.0	3.8	4.7	4.7
500 to 999.....																	2.3	2.4	2.7	2.4
1,000 to 4,999.....		1.8	1.8	2.4	1.7	1.7	1.5	1.4	1.4	1.6	1.6	1.8	1.8	1.7	1.9	2.0	2.2	2.6	2.7	2.6
5,000 to 9,999.....					2.1	1.9	1.8	1.8	1.9	2.0	1.4	1.3	1.4	2.1	1.7	1.7	1.8	1.9	2.3	2.3
10,000 to 24,999.....		3.9	4.8	5.3		1.9	1.6	1.7	1.8	1.9	1.9	1.7	1.7	1.9	2.4	2.8	3.1	3.1	3.2	3.3
25,000 or more.....					5.2	4.7	4.2	4.5	4.2	4.2	4.0	3.8	4.0	4.6	5.4	5.5	5.3	6.2	6.5	6.6

(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

(2) Not separately available but included in total. See general notes.

(3) Included in other manufacturing industries group.

(4) Data not tabulated at this level prior to 1972.

(5) Data not tabulated at this level prior to 1977.

(6) Included in the other electrical equipment group.

SOURCE: National Science Foundation, SRS

Table B-22. Companies' own R&D funds as a percent of net sales in R&D-performing manufacturing companies by industry and size of company: 1957-58, 1963, 1967, 1972, and 1974-87

Industry and size of company	SIC code	1957	1958	1963	1967	1972	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total.....		1.5	1.6	1.9	2.1	2.0	2.0	2.0	2.0	2.0	2.0	1.9	2.1	2.2	2.6	2.6	2.6	3.0	3.3	3.2
Distribution by industry																				
Food, kindred, and tobacco products(1).....	20,21	0.3	0.3	(B)	0.5	0.4	0.4	(B)	(B)	(B)	(B)	(B)	(B)	0.4	0.4	0.5	0.5	0.7	0.7	0.7
Textiles and apparel.....	22,23	(2)	0.2	0.4	(B)	0.4	(B)	(B)	(B)	(B)	(B)	(B)	(B)	0.4	0.5	0.4	0.5	0.5	0.5	0.4
Lumber, wood products, and furniture.....	24,25	(2)	0.4	(B)	0.3	(B)	(B)	0.7	0.7	0.9	0.7	0.7	0.9	0.8	1.0	1.0	0.9	1.0	0.8	0.6
Paper and allied products.....	26	0.6	0.7	0.8	(B)	0.8	(B)	(B)	(B)	(B)	(B)	(B)	1.0	1.0	1.1	0.9	0.8	0.8	0.7	0.7
Chemicals and allied products.....	28	3.1	3.2	3.6	4.0	3.3	3.0	3.1	3.3	3.3	3.2	3.2	3.3	3.4	4.0	4.2	4.6	4.9	5.1	5.2
Industrial chemicals.....	281-82,286	4.2	4.3	4.1	3.9	3.2	2.9	3.1	3.1	3.0	2.9	2.6	2.8	2.9	3.5	3.4	3.8	4.2	4.4	4.6
Drugs and medicines.....	283	3.6	4.0	4.5	(B)	(B)	(B)	(B)	(B)	(B)	(B)	(B)	6.1	6.3	7.0	7.7	8.2	8.0	8.4	8.5
Other chemicals.....	284-85,287-89	1.2	1.3	1.9	(B)	(B)	(B)	(B)	(B)	(B)	(B)	(B)	1.9	2.1	2.3	2.5	2.9	3.1	3.3	3.3
Petroleum refining and extraction.....	13,29	0.7	1.1	1.2	0.9	0.7	0.5	(B)	0.6	0.6	0.7	0.6	0.5	0.6	0.8	0.7	0.7	0.9	1.1	1.0
Rubber products.....	30	1.1	1.4	1.6	1.7	1.7	(B)	(B)	(B)	(B)	(B)	(B)	1.9	2.2	2.2	2.4	2.3	2.2	1.8	1.8
Stone, clay, and glass products.....	32	(3)	(3)	1.6	1.7	1.6	1.5	(B)	(B)	(B)	(B)	(B)	1.3	1.4	1.7	1.9	1.9	2.3	2.4	2.6
Primary metals.....	33	0.5	0.6	0.7	0.8	0.7	0.5	0.7	0.8	0.7	0.6	0.5	0.5	0.7	0.9	0.8	0.9	0.9	1.0	0.8
Ferrous metals and products.....	331-32,3398-99	(2)	0.6	0.7	0.7	0.6	(B)	0.6	0.6	0.6	0.5	0.5	0.5	0.6	0.7	0.7	0.7	0.6	0.8	0.6
Nonferrous metals and products.....	333-34	(2)	0.6	0.9	0.9	0.9	(B)	1.1	1.1	0.9	0.8	0.6	0.6	1.0	1.2	1.1	1.1	1.3	1.4	1.2
Fabricated metal products.....	34	1.1	1.1	1.4	1.2	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.2	1.2	1.3	1.5	1.7	1.8	1.8	1.6
Machinery.....	35	2.0	2.1	3.1	3.2	3.5	3.9	4.0	4.2	4.3	4.2	4.2	4.5	4.4	5.0	5.4	5.8	6.7	7.4	7.6
Office, computing, and accounting machines.....	357	(4)	(4)	(4)	(4)	(B)	(B)	9.4	9.1	9.6	9.8	10.1	10.4	9.7	10.2	9.9	10.3	11.7	11.7	12.6
Other machinery, except electrical.....	351-56,358-59	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	2.1	2.0	2.0	2.2	2.3	2.5	2.6	2.7	3.0	3.9	3.5
Electrical equipment.....	36	2.6	3.3	3.6	3.5	3.5	3.5	3.6	3.7	3.4	3.4	3.6	3.9	4.2	4.7	5.3	4.8	5.1	5.4	5.4
Radio and TV receiving equipment.....	365	(6)	(6)	(6)	(B)	(B)	(B)	1.4	1.4	1.6	1.4	1.7	2.7	2.6	3.3	2.9	3.7	4.3	3.6	3.2
Communication equipment.....	364	(2)	3.3	4.2	3.9	3.9	3.9	4.2	4.3	4.4	4.5	5.0	5.4	6.0	6.8	7.3	5.2	5.5	5.3	5.4
Electronic components.....	367	(2)	3.3	3.0	(B)	3.7	3.9	(B)	(B)	(B)	(B)	(B)	5.9	5.7	5.2	6.6	6.6	8.2	9.2	8.7
Other electrical equipment.....	361-64,369	(2)	3.3	3.0	(B)	(B)	(B)	(B)	(B)	(B)	(B)	(B)	2.5	2.8	2.8	3.1	2.7	2.5	2.7	3.0
Transportation equipment.....	37																3.3	3.4	3.6	3.4
Motor vehicles and motor vehicles equipment.....	371					2.8	3.2	3.0	2.7	2.7	2.9	3.2	4.2	3.9	4.0	3.5	3.0	3.1	3.3	3.3
Other transportation equipment.....	373-75,379	2.1	2.8	2.5	2.5	0.6	0.6	0.6	0.6	0.7	(B)	(B)	0.3	0.3	0.7	1.7	2.0	2.3	2.7	2.4
Aircraft and missiles.....	372,376	2.0	2.3	2.6	4.0	3.3	3.5	2.8	2.8	2.9	3.2	3.5	3.8	4.6	5.0	4.0	3.9	3.8	3.9	3.7
Professional and scientific instruments.....	38	3.9	4.1	4.2	3.5	4.8	5.2	5.1	5.4	5.4	5.7	5.0	6.1	6.7	7.4	7.8	7.7	8.4	8.3	8.4
Scientific and mechanical measuring instruments...	381-82	4.0	4.0	3.1	2.5	3.8	4.4	4.7	5.3	5.7	5.9	5.0	6.2	6.9	7.6	8.0	8.3	8.4	8.4	8.1
Optical, surgical, photographic, and other instruments.....	383-87	3.8	4.1	4.0	3.9	5.1	5.5	5.2	5.5	5.4	5.6	5.9	6.0	6.6	7.2	7.2	7.4	8.4	8.3	8.5
Other manufacturing industries.....	27,31,39	(2)	(B)	0.6	(B)	(B)	(B)	0.7	0.7	0.6	0.5	0.4	0.4	0.4	0.8	1.0	1.1	1.0	1.2	1.1
Distribution by size of company (based on number of employees)																				
Less than 500.....		1.4	0.7	1.5	1.6	1.5	1.6	1.4	1.5	1.5	1.4	1.5	1.2	1.4	2.1	1.8	1.9	3.6	4.7	4.6
500 to 999.....																	2.2	2.2	2.5	2.3
1,000 to 4,999.....		1.2	1.3	1.5	1.4	1.3	1.2	1.2	1.2	1.4	1.4	1.4	1.4	1.5	1.7	2.0	2.0	2.4	2.6	2.5
5,000 to 9,999.....					1.6	1.5	1.4	1.5	1.6	1.5	1.2	1.1	1.1	1.7	1.5	1.3	1.6	1.8	2.0	2.1
10,000 to 24,999.....		1.6	1.9	2.1		1.4	1.3	1.5	1.4	1.4	1.4	1.4	1.4	1.6	2.0	2.3	2.5	2.5	2.6	2.7
25,000 or more.....					2.3	2.5	2.4	2.6	2.5	2.4	2.5	2.4	2.5	2.7	3.3	3.4	3.2	3.5	3.7	3.7

(B) Data have been withheld to avoid disclosing operations of individual companies.

(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

(2) Not separately available but included in total. See general notes.

(3) Data included in other manufacturing industries group.

(4) Data not tabulated at this level prior to 1972.

(5) Data not tabulated at this level prior to 1977.

(6) Included in the other electrical equipment group.

SOURCE: National Science Foundation, SRS

Table B-23. Companies' own and Federal R&D funds as a percent of net sales in R&D-performing manufacturing companies ranked by size of R&D program, by industry: 1987

Industry	SIC code	Companies' own and Federal R&D funds as a percent of net sales [Percent]			Companies' own and Federal R&D funds [Dollars in millions]		
		First 4 companies	Next 4 companies	Next 12 companies	First 4 companies	Next 4 companies	Next 12 companies
Total.....		10.4	10.6	13.9	\$17,284	\$11,793	\$14,782
Food, kindred, and tobacco products.....	20,21	2.0	1.1	0.6	608	190	304
Textiles and apparel.....	22,23	0.9	0.4	0.5	85	54	41
Lumber, wood products, and furniture.....	24,25	0.9	1.1	0.4	46	28	31
Paper and allied products.....	26	1.2	1.2	0.6	246	111	151
Chemicals and allied products.....	28	6.3	12.1	8.2	2,693	1,388	2,542
Industrial chemicals.....	281-82,286	7.0	3.9	3.3	2,474	517	608
Drugs and medicines.....	283	12.1	8.7	8.4	1,388	1,053	1,429
Other chemicals.....	284-85,287-89	4.9	3.9	3.2	957	295	306
Petroleum refining and extraction.....	13,29	1.5	0.9	0.7	1,123	504	255
Rubber products.....	30	5.6	3.8	2.0	705	150	145
Stone, clay, and glass products.....	32	6.6	1.8	1.2	751	131	99
Primary metals.....	33	(D)	1.1	1.2	(D)	120	180
Ferrous metals and products.....	331-32,3398-99	(D)	(S)	1.0	(D)	63	83
Nonferrous metals and products.....	333-36	2.2	1.2	1.1	243	82	94
Fabricated metal products.....	34	10.7	(S)	1.5	486	188	202
Machinery.....	35	18.2	7.4	11.1	6,910	969	1,554
Office, computing, and accounting machines.....	357	17.7	12.2	12.3	6,774	739	1,110
Other machinery, except electrical.....	351-56,358-59	7.4	(D)	3.7	1,037	(D)	408
Electrical equipment.....	36	12.0	9.7	10.2	6,903	2,426	3,222
Radio and TV receiving equipment.....	365	(D)	3.4	1.3	(D)	12	14
Communication equipment.....	366	10.3	13.4	7.4	6,134	1,483	1,294
Electronic components.....	367	11.4	20.8	13.7	1,914	764	756
Other electrical equipment.....	361-64,369	12.2	4.0	1.6	2,060	160	228
Transportation equipment.....	37	9.9	11.2	9.0	15,750	9,269	7,083
Motor vehicles and motor vehicle equipment.....	371	(D)	2.3	0.8	(D)	265	182
Other transportation equipment.....	373-75,379	5.2	2.0	0.8	460	18	22
Aircraft and missiles.....	372,376	18.3	17.9	10.1	12,700	6,565	4,028
Professional and scientific instruments.....	38	11.3	9.1	8.2	2,948	746	678
Scientific and mechanical measuring instruments....	381-82	10.5	9.9	8.1	1,040	117	148
Optical, surgical, photographic, and other instruments.....	383-87	11.2	8.3	9.2	2,361	652	358
Other manufacturing industries.....	27,31,39	2.7	2.4	1.2	154	66	80

Note: Rankings were based on companies' own and Federal R&D funds.

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of more than 50 percent.

SOURCE: National Science Foundation, SBS

Table B-24. Companies' own R&D funds as a percent of net sales in R&D-performing manufacturing companies ranked by size of company-financed R&D program, by industry: 1987

Industry	SIC code	Companies' own R&D funds as a percent of net sales [Percent]			Companies' own R&D funds [Dollars in millions]		
		First 4 companies	Next 4 companies	Next 12 companies	First 4 companies	Next 4 companies	Next 12 companies
Total.....		6.0	5.9	6.4	\$12,558	\$4,424	\$7,525
Food, kindred, and tobacco products.....	20,21	2.0	1.1	0.6	607	190	304
Textiles and apparel.....	22,23	0.9	0.4	0.5	85	54	41
Lumber, wood products, and furniture.....	24,25	0.9	1.1	0.4	46	28	31
Paper and allied products.....	26	1.2	1.2	0.6	246	111	151
Chemicals and allied products.....	28	6.0	12.1	8.2	2,551	1,388	2,538
Industrial chemicals.....	281-82,286	7.2	3.1	3.1	2,332	508	577
Drugs and medicines.....	283	12.1	8.7	8.4	1,388	1,052	1,429
Other chemicals.....	284-85,287-89	4.9	3.9	3.2	957	295	306
Petroleum refining and extraction.....	13,29	1.5	0.9	0.7	1,120	503	244
Rubber products.....	30	3.1	3.8	1.9	383	150	136
Stone, clay, and glass products.....	32	6.6	1.8	1.2	743	130	98
Primary metals.....	33	0.9	1.1	1.5	259	119	180
Ferrous metals and products.....	331-32,3398-99	0.5	(S)	1.0	134	63	83
Nonferrous metals and products.....	333-36	2.2	1.2	1.1	236	82	92
Fabricated metal products.....	34	9.7	(S)	1.5	448	173	198
Machinery.....	35	15.2	7.4	11.0	5,769	964	1,542
Office, computing, and accounting machines.....	357	14.7	12.2	12.3	5,632	739	1,110
Other machinery, except electrical.....	351-56,358-59	7.2	(D)	3.7	1,020	(D)	406
Electrical equipment.....	36	8.6	3.9	6.3	4,027	1,098	2,345
Radio and TV receiving equipment.....	365	(D)	3.4	1.3	(D)	12	14
Communication equipment.....	366	7.2	3.4	5.0	3,581	841	646
Electronic components.....	367	12.4	(S)	13.5	1,491	673	714
Other electrical equipment.....	361-64,369	5.1	3.9	1.6	866	158	228
Transportation equipment.....	37	4.2	4.0	3.1	8,435	2,409	1,766
Motor vehicles and motor vehicles equipment.....	371	3.9	1.8	0.7	6,851	199	162
Other transportation equipment.....	373-75,379	3.5	2.0	0.8	311	18	22
Aircraft and missiles.....	372,376	4.8	3.3	2.4	3,678	1,243	796
Professional and scientific instruments.....	38	11.0	8.2	7.1	2,859	647	612
Scientific and mechanical measuring instruments.....	381-82	(D)	(D)	8.9	(D)	(D)	145
Optical, surgical, photographic, and other instruments.....	383-87	9.0	14.2	9.2	2,262	547	358
Other manufacturing industries.....	27,31,39	2.7	2.4	1.2	154	66	80

Note: Rankings were based on companies' own R&D funds.

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of 50 percent or more.

SOURCE: National Science Foundation, SRS

Table B-25. Federal R&D funds as a percent of net sales in R&D-performing manufacturing companies ranked by size of Federal R&D program, by industry: 1987

Industry	SIC code	Federal R&D funds as a percent of net sales [Percent]			Federal R&D funds [Dollars in millions]		
		First 4 companies	Next 4 companies	Next 12 companies	First 4 companies	Next 4 companies	Next 12 companies
Total.....		14.5	4.2	5.1	\$9,559	\$5,757	\$8,229
Food, kindred, and tobacco products.....	20,21	0.0	0.0	0.0	2	0	0
Textiles and apparel.....	22,23	(D)	0.0	0.0	(D)	0	0
Lumber, wood products, and furniture.....	24,25	0.0	0.0	0.0	0	0	0
Paper and allied products.....	26	(D)	0.0	0.0	(D)	0	0
Chemicals and allied products.....	28	0.5	0.2	0.1	166	13	13
Industrial chemicals.....	281-82,286	0.5	0.2	0.1	166	13	8
Drugs and medicines.....	283	0.0	(D)	0.0	3	(D)	0
Other chemicals.....	284-85,287-89	(D)	0.0	0.0	(D)	0	0
Petroleum refining and extraction.....	13,29	0.0	0.0	(D)	13	1	(D)
Rubber products.....	30	(D)	(D)	0.0	(D)	(D)	0
Stone, clay, and glass products.....	32	(D)	(D)	0.0	(D)	(D)	0
Primary metals.....	33	(D)	(D)	0.0	(D)	(D)	1
Ferrous metals and products.....	331-32,3398-99	(D)	(D)	0.0	(D)	(D)	0
Nonferrous metals and products.....	333-36	0.1	0.0	(D)	9	1	(D)
Fabricated metal products.....	34	(D)	0.4	(D)	(D)	19	(D)
Machinery.....	35	(D)	(D)	0.7	(D)	(D)	20
Office, computing, and accounting machines.....	357	(D)	(D)	0.0	(D)	(D)	0
Other machinery, except electrical.....	351-56,358-59	0.3	0.6	0.3	31	9	7
Electrical equipment.....	36	6.0	6.2	3.9	3,455	1,267	931
Radio and TV receiving equipment.....	365	0.0	0.0	0.0	0	0	0
Communication equipment.....	366	4.5	9.8	5.4	2,679	924	365
Electronic components.....	367	3.5	6.1	0.6	545	88	21
Other electrical equipment.....	361-64,369	(D)	0.1	(S)	(D)	3	1
Transportation equipment.....	37	14.5	4.0	5.0	9,559	5,532	4,629
Motor vehicles and motor vehicles equipment.....	371	(D)	(D)	0.0	(D)	(D)	0
Other transportation equipment.....	373-75,379	2.3	0.0	0.0	149	0	0
Aircraft and missiles.....	372,376	14.5	12.8	7.6	9,559	5,161	2,922
Professional and scientific instruments.....	38	1.3	0.7	0.1	248	16	9
Scientific and mechanical measuring instruments.....	381-82	(D)	0.0	0.7	(D)	1	(1)
Optical, surgical, photographic, and other instruments.....	383-87	(D)	0.5	(S)	(D)	10	(S)
Other manufacturing industries.....	27,31,39	(D)	0.0	0.0	(D)	0	0

Note: Rankings were based on Federal R&D funds.

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of 50 percent or more.

SOURCE: National Science Foundation, SRS

Table D-20. Companies' own and Federal funds for industrial applied R&D performance by product field: 1963-64, 1967-68, 1970-71, 1976, 1981, 1983, 1985, and 1987

		(Dollars in millions)															
Product field	RIC Code	1963	1964	1967	1970	1971	1972	1973	1974	1975	1976	1977	1978	1981	1983	1985(1)	1987(1)
Total.....		\$12,100	\$12,002	\$16,757	\$18,707	\$17,405	\$17,730	\$18,050	\$20,010	\$22,100	\$23,457	\$20,170	\$20,014	\$27,000	\$50,100	\$60,712	\$64,255
Food and kindred products.....	20	102	110	134	165	206	211	227	243	283	273	300	340	420	402	424	404
Textile mill products.....	22	(2)	(2)	55	55	55	80	83	82	73	81	80	(2)	(2)	(2)	214	72
Chemicals and allied products.....	28, except 283	1,000	1,103	1,404	1,543	1,700	1,851	1,701	1,840	2,240	2,410	2,730	2,074	3,500	5,104	6,634	4,513
Industrial inorganic and organic chemicals.....	281-286	242	304	347	300	442	457	451	400	500	605	720	610	(2)	1,920	1,140	740
Plastics materials and synthetic resins, rubber, and fibers.....	282	370	402	474	400	521	511	453	511	500	500	474	744	801	1,060	1,300	803
Drugs and medicines.....	283	227	234	340	375	474	535	531	605	603	703	603	655	1,000	1,037	2,601	1,654
Agricultural chemicals.....	287	45	40	82	90	120	130	100	114	137	170	205	230	202	407	507	432
Other chemicals.....	284-85, 288	100	105	205	207	223	210	230	220	240	100	240	220	(2)	700	940	831
Petroleum refining.....	20	104	205	215	230	272	200	200	310	303	400	425	471	650	875	920	503
Rubber and miscellaneous plastics products.....	20	87	102	132	100	103	215	270	204	341	324	325	370	107	(2)	(2)	210
Stones, clay, and glass products.....	32	74	85	121	130	120	120	135	102	101	150	171	191	235	210	104	174
Primary metals.....	33	152	104	200	207	235	230	245	272	311	200	311	327	430	604	550	201
Nonferrous metals and products.....	331-33, 3300-80	80	87	117	110	127	114	137	150	150	144	103	172	225	200	270	105
Ferrous metals and products.....	333-38	82	80	81	80	100	110	100	114	155	147	140	155	213	410	200	150
Fabricated metal products.....	34	227	244	422	870	814	803	800	807	1,126	1,103	1,324	1,440	1,007	1,071	(2)	1,332
Ordinance and accessories, n.e.c.....	240	82	84	210	201	102	102	177	220	222	107	100	200	310	453	(2)	413
Other fabricated metal products.....	341-47, 340	135	150	204	470	622	701	731	700	803	810	1,026	1,152	1,301	1,510	1,370	810
Machinery.....	35	813	870	1,203	1,390	1,070	1,703	1,000	2,307	2,000	2,020	2,001	3,554	4,561	6,200	7,452	7,300
Engines and turbines.....	351	124	120	182	203	204	240	310	360	402	404	477	520	500	804	1,190	710
Pump machinery and equipment.....	352	70	70	102	80	80	80	83	120	131	130	160	221	295	270	200	220
Construction, mining, and materials handling machinery.....	353	50	80	110	120	102	106	200	205	203	205	317	370	632	560	500	423
Metallurgical machinery and equipment.....	354	80	80	87	80	80	84	70	60	74	80	63	125	340	227	244	120
Office, computing, and accounting machines.....	357	412	450	814	870	803	903	1,020	1,219	1,422	1,330	1,500	1,010	1,961	3,220	4,081	5,579
Other machinery, except electrical.....	355-50, 350-50	105	102	190	201	252	204	270	274	207	322	370	455	744	1,490	1,122	313
Electrical equipment.....	36	2,420	2,020	3,053	3,303	3,373	3,015	4,060	4,470	4,025	4,005	5,357	5,020	7,070	(2)	(2)	10,292
Electric transmission and distribution equipment.....	361, 3025	47	40			101	100	204	230	205	224	224	191	(2)	(2)	(2)	150
Electrical industrial apparatus.....	362	77	84			107	231	203	264	200	306	200	201	(2)	(2)	(2)	302
Radio and TV receiving equipment.....	365																(8)
Communication equipment.....	360	2,150	2,222			2,027	3,234	3,021	3,090	3,011	4,403	5,010	0,090	(2)	(2)	(2)	0,130
Electronic components.....	367																3,717
Other electrical equipment and supplies.....	363-64, 360-80	152	175			320	350	390	420	300	344	370	490	653	1,002	821	752
Transportation equipment.....	37	6,510	6,044	0,737	7,112	0,007	0,050	0,711	7,053	0,000	7,114	(2)	(2)	(2)	(2)	(2)	10,401
Motor vehicles and equipment.....	371	823	851	765	800	1,040	1,220	1,470	1,024	1,704	1,720	(2)	(2)	(2)	(2)	(2)	4,000
Other transportation equipment.....	272-75, 370	20	27	70	80	80	113	100	190	210	204	103	201	205	(2)	377	104
Aircraft and parts.....	372	1,520	1,070	2,105	2,370	2,550	2,400	2,300	2,540	2,420	2,205	2,733	3,113	3,460	4,024	0,077	3,947
Guided missiles and spacecraft.....	370	3,345	2,486	3,741	3,700	3,115	2,032	2,047	2,491	2,400	2,025	2,000	3,024	4,405	4,014	0,004	3,050
Professional and scientific instruments.....	20, except 2025	200	340	835	710	724	852	847	801	1,000	1,002	1,140	1,256	1,434	1,400	1,012	1,127
Scientific and mechanical measuring instruments.....	381-82																809
Optical, nongraphical, photographic, and other instruments.....	383-87																350
Other product fields, n.e.c.....	-	1,030	1,172	1,305	1,012	1,104	1,177	1,440	1,405	1,742	2,007	2,170	3,201	4,002	5,057	0,001	5,700

n.e.c. Not elsewhere classified.

(1) Imputation of R&D expenditures by product field was eliminated beginning in 1985. See Table D-20 for 'coverage ratios.'

(2) Not separately available but included in total. See general notes.

(3) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SNS

Table B-27. Funds for industrial applied R&D performance
by product field and source of funds: 1987

[Dollars in millions]				
Product field	SIC Code	Total	Federal	Company
Total.....		\$47,144	\$18,858	\$28,286
Food and kindred products.....	20	464	0	464
Textile mill products.....	22	72	(B)	(B)
Chemicals, except drugs and medicines.....	28, except 283	4,354	53	4,301
Industrial inorganic and organic chemicals.....	281,286	458	(B)	(B)
Plastics materials and synthetic resins, rubber, and fibers.....	282	983	13	970
Drugs and medicines.....	283	1,913	(B)	(B)
Agricultural chemicals.....	287	398	0	398
Other chemicals.....	284-85,289	602	(B)	(B)
Petroleum refining.....	29	583	(B)	(B)
Rubber and miscellaneous plastics products.....	30	219	(B)	(B)
Stone, clay, and glass products.....	32	175	9	166
Primary metals.....	33	223	46	177
Ferrous metals and products.....	331-32,3398-99	126	37	89
Nonferrous metals and products.....	333-36	97	9	88
Fabricated metal products.....	34	1,164	770	394
Ordnance and accessories, n-e.c.....	348	208	160	48
Other fabricated metal products.....	341-47,349	956	610	346
Machinery.....	35	6,191	367	5,824
Engines and turbines.....	351	625	(B)	(B)
Farm machinery and equipment.....	352	198	0	198
Construction, mining, and materials handling machinery.....	353	324	(B)	(B)
Metalworking machinery and equipment.....	354	146	(B)	(B)
Office, computing, and accounting machines.....	357	4,573	(B)	(B)
Other machinery, except electrical.....	355-56,358-59	325	(B)	(B)
Electrical equipment.....	36	9,770	3,822	5,947
Electric transmission and distribution equipment..	361,3825	(B)	(B)	72
Electrical industrial apparatus.....	362	149	41	108
Radio and TV receiving equipment.....	365	(B)	(B)	58
Communication equipment.....	366	4,771	1,618	3,153
Electronic components.....	367	3,747	1,894	1,853
Other electrical equipment and supplies.....	363-64,368-69	752	49	703
Transportation equipment.....	37	16,491	(B)	(B)
Motor vehicles and equipment.....	371	4,009	60	3,949
Other transportation equipment.....	373-75,379	137	(B)	(B)
Aircraft and parts.....	372	7,513	4,956	2,557
Guided missiles and spacecraft.....	376	4,832	4,386	446
Professional and scientific instruments.....	38, except 3825	959	113	846
Scientific and mechanical measuring instruments...	381-82	609	88	521
Optical, surgical, photographic, and other instruments.....	383-87	350	25	325
Other product fields, n-e.c.....	-	6,480	4,201	2,283

n-e.c. Not elsewhere classified.

(B) Data have been withheld to avoid disclosing operations of individual companies.

NOTE: This table contains only data reported by survey respondents. Imputation of R&D expenditures by product field was eliminated beginning in 1985. See Table B-28 for "coverage ratios."

SOURCE: National Science Foundation, SRS

Table D-26. Companies' own and Federal funds for industrial applied R&D performance by industry and product field: 1967

(Dollars in millions)

Industry	DIC Code	Total	Coverage ratio	Food and kindred products 20	Tenille mill products 22	Chemicals 26	Petroleum refining 29	Rubber products 30	Glass, clay, and glass products 32	Primary metals 33	Fabricated metal products 34	Machinery 35	Electrical equipment 36	Transportation equipment 37	Professional and scientific instruments 38	Other product fields N.E.C. ...
Total.....		891,737	0-51	1464	972	84,354	9583	9219	6175	6223	41,145	66,191	99,778	916,491	9959	86,480
Food, kindred, and tobacco products.....	20-21	(0)	0-33	318	0	29	0	(0)	(0)	0	(0)	(0)	5	0	0	72
Textiles and apparel.....	22-23	(0)	0-30	0	35	(0)	0	(0)	0	0	0	(0)	(0)	(0)	0	2
Lumber, wood products, and furniture.....	24-25	(0)	0-32	0	(0)	(0)	0	0	0	0	(0)	13	(0)	(0)	0	19
Paper and allied products.....	26	879	0-44	(0)	(0)	23	0	(0)	(0)	0	(0)	27	(0)	(0)	(0)	200
Chemicals and allied products.....	28	9,023	0-68	100	2	3,379	7	(0)	(0)	12	(0)	(0)	(0)	(0)	212	395
Industrial chemicals.....	281-82,286	3,453	0-43	(0)	(0)	915	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	234
Drugs and medicines.....	283	3,795	0-49	(0)	(0)	1,439	0	(0)	(0)	(0)	(0)	0	(0)	0	98	(0)
Dietary chemicals.....	284-85,287-89	1,775	0-57	(0)	(0)	825	(0)	(0)	0	(0)	(0)	0	(0)	(0)	(0)	(0)
Petroleum refining and extraction.....	13,29	1,000	0-67	(0)	(0)	374	567	(0)	(0)	(0)	(0)	(0)	28	(0)	(0)	222
Rubber products.....	30	(0)	0-16	0	0	(0)	0	189	(0)	(0)	(0)	9	(0)	(0)	(0)	0
Glass, clay, and glass products.....	32	889	0-24	0	(0)	(0)	0	(0)	104	0	0	(0)	(0)	17	(0)	(0)
Primary metals.....	33	1,305	0-75	(0)	0	18	(0)	(0)	(0)	77	39	(0)	(0)	(0)	(0)	9
Ferrous metals and products.....	331-32,339-99	940	0-82	0	0	(0)	(0)	(0)	(0)	47	0	2	(0)	(0)	0	0
Nonferrous metals and products.....	333-36	365	0-56	(0)	0	(0)	(0)	(0)	(0)	30	31	(0)	(0)	(0)	(0)	9
Fabricated metal products.....	34	(0)	0-20	(0)	0	68	0	3	(0)	24	81	20	12	6	(0)	(0)
Machinery.....	35	12,341	0-60	(0)	(0)	9	(0)	(0)	(0)	(0)	50	4,571	(0)	37	9	1,132
Office, computing, and accounting machines.....	357	9,438	0-69	(0)	0	(0)	0	0	0	0	0	3,963	(0)	0	(0)	1,049
Other machinery, except electrical.....	351-56,358-99	(0)	0-30	(0)	(0)	(0)	(0)	(0)	(0)	(0)	50	600	33	37	(0)	83
Electrical equipment.....	36	18,842	0-52	0	0	28	0	(0)	(0)	(0)	(0)	372	4,421	170	110	2,118
Radio and TV receiving equipment.....	365	(0)	0-01	0	0	0	0	0	0	0	0	0	(0)	0	0	0
Communication equipment.....	366	8,940	0-73	0	0	(0)	0	(0)	(0)	(0)	(0)	370	4,020	162	69	1,859
Electronic components.....	367	(0)	0-18	0	0	(0)	0	0	0	0	3	(0)	505	(0)	(0)	(0)
Other electrical equipment.....	361-64,369	1,685	0-41	0	0	1	0	(0)	0	0	(0)	(0)	(0)	(0)	(0)	(0)
Transportation equipment.....	37	33,813	0-66	(0)	(0)	218	9	25	21	96	433	800	3,102	18,334	(0)	1,769
Motor vehicles and motor vehicles equipment.....	371	9,339	0-68	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Other transportation equipment.....	373-75,379	(0)	0-37	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)
Aircraft and missiles.....	372,376	23,167	0-67	(0)	(0)	118	(0)	7	(0)	35	243	263	2,460	18,700	125	1,077
Professional and scientific instruments....	38	(0)	0-13	0	0	15	0	(0)	0	0	(0)	18	172	0	390	48
Scientific and mechanical measuring instruments.....	381-82	(0)	0-14	0	0	(0)	0	0	0	0	(0)	(0)	105	(0)	108	12
Optical, surgical, photographic, and other instruments.....	383-87	(0)	0-13	0	0	(0)	0	(0)	0	0	0	(0)	67	(0)	296	33
Other manufacturing industries.....	27,31,39	(0)	0-30	0	(0)	(0)	0	(0)	0	0	0	(0)	(0)	0	0	37
Nonmanufacturing industries.....	00,10-12,14-17, 40-67,72-73, 80-87,891	(0)	0-15	(0)	0	78	(0)	(0)	(1)	(1)	(0)	282	162	187	89	391

(0) Data have been withheld to avoid disclosing operations of individual companies.

(1) Data have been withheld due to imputation of 50 percent or more.

NOTE: Imputation of R&D expenditures by product field was eliminated beginning in 1965. Coverage ratios show the percentage of each industry's applied research and development funds that respondents distributed by product field.

SOURCE: National Science Foundation, R&D

Table B-29. Companies' own and Federal funds for industrial applied R&D performance by industry and secondary product field: 1987

[Dollars in millions]

Industry	SIC Code	Chemicals				Primary metals			Fabricated metal products
		Industrial inorganic and organic chemicals 281,286	Plastics, synthetic resins, rubber, and fibers 282	Drugs and medicines 283	Agricultural chemicals 287	Other chemicals 284-85, 289	Ferrous metals and products 331-32, 3398-99	Nonferrous metal and products 333-36	
Total.....		\$458	\$983	\$1,913	\$398	\$602	\$126	\$97	\$2,000
Food, kindred, and tobacco products.....	20,21	(D)	21	(D)	1	(D)	0	0	(D)
Textiles and apparel.....	22,23	0	(D)	0	0	(D)	0	0	(D)
Lumber, wood products, and furniture.....	24,25	(D)	(D)	0	0	0	0	0	(D)
Paper and allied products.....	26	8	(D)	0	(D)	(D)	0	0	(D)
Chemicals and allied products.....	28	267	468	1,890	342	412	(D)	(D)	(D)
Industrial chemicals.....	281-82,286	140	(D)	(D)	(D)	47	(D)	0	(D)
Drugs and medicines.....	283	48	(D)	1,412	(D)	30	0	(D)	(D)
Other chemicals.....	284-85,287-89	79	20	(D)	(D)	334	0	(D)	(D)
Petroleum refining and extraction.....	13,29	83	161	(D)	(D)	85	(D)	(D)	(D)
Rubber products.....	30	0	(D)	0	0	(D)	0	(D)	(D)
Stone, clay, and glass products.....	32	(D)	(D)	(D)	(D)	(D)	0	0	(D)
Primary metals.....	33	6	(D)	0	0	(D)	47	30	(D)
Ferrous metals and products.....	331-32,3398-99	(D)	(D)	0	0	0	(D)	(D)	(D)
Nonferrous metals and products.....	333-36	(D)	(D)	0	0	(D)	(D)	(D)	(D)
Fabricated metal products.....	34	(D)	19	0	0	(D)	(D)	(D)	(D)
Machinery.....	35	(D)	1	0	0	(D)	0	(D)	(D)
Office, computing, and accounting machines.....	357	0	0	0	0	(D)	0	0	(D)
Other machinery, except electrical.....	351-56,358-59	(D)	1	0	0	(D)	0	(D)	(D)
Electrical equipment.....	36	(D)	(D)	(D)	0	(D)	(D)	(D)	(D)
Radio and TV receiving equipment.....	365	0	0	0	0	0	0	0	(D)
Communication equipment.....	366	(D)	(D)	0	0	0	(D)	(D)	(D)
Electronic components.....	367	(D)	0	0	0	(D)	0	0	(D)
Other electrical equipment.....	361-64,369	0	(D)	(D)	0	(D)	0	0	(D)
Transportation equipment.....	37	(D)	174	0	(D)	21	(D)	(D)	(D)
Motor vehicles and motor vehicles equipment.....	371	(D)	(D)	0	0	(D)	(D)	(D)	(D)
Other transportation equipment.....	373-75,379	0	(D)	0	0	(D)	(D)	(D)	(D)
Aircraft and missiles.....	372,376	(D)	(D)	0	(D)	(D)	(D)	(D)	(D)
Professional and scientific instruments....	38	(D)	(D)	0	0	(D)	0	0	(D)
Scientific and mechanical measuring instruments.....	381-82	(D)	(D)	0	0	0	0	0	(D)
Optical, surgical, photographic, and other instruments.....	383-87	0	(D)	0	0	(D)	0	0	(D)
Other manufacturing industries.....	27,31,39	0	(D)	0	0	0	0	0	(D)
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	22	(D)	(D)	(D)	34	0	(1)	(D)

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of 50 percent or more.

(1) Less than \$0.5 million.

NOTE: Imputation of R&D expenditures by product field was eliminated beginning in 1985. See Table B-28 for "coverage ratios."

SOURCE: National Science Foundation, SRS

Table D-25. Companies' own and Federal funds for industrial applied R&D performance by industry and secondary product field: 1967 (continued)

Industry	SIC Code	Machinery						Electrical equipment					
		Engines and turbines 351	Farm machinery and equipment 352	Construction, mining, and materials handling machinery and equipment 353	Metal-working machinery and equipment 354	Office, computing, and accounting machines 357	Other machinery, except electrical 353-36, 358-39	Electric transmission and distribution equipment 361, 362, 363	Radio and television receiving sets, except communications equipment 364	Electronic computers and accessories 365	Other electrical equipment and supplies 366-39	Other electrical equipment and supplies 363-64, 366-69	
Total.....		6425	6198	6326	6166	64,573	6325	(D)	6169	(D)	64,771	63,747	6752
Food, kindred, and tobacco products.....	20, 21	0	0	(D)	0	0	(D)	0	(D)	0	(D)	(D)	0
Textiles and apparel.....	22, 23	0	0	0	0	0	(D)	0	(D)	0	0	(D)	0
Lumber, wood products, and furniture.....	24, 25	0	(D)	(D)	0	(D)	(D)	0	0	0	(D)	(D)	(D)
Paper and allied products.....	26	0	0	0	0	(D)	(D)	0	(D)	0	0	(D)	0
Chemicals and allied products.....	28	0	0	0	0	0	(D)	0	(D)	0	(D)	(D)	0
Industrial chemicals.....	281-62, 286	0	0	0	0	0	(D)	0	(D)	0	(D)	(D)	0
Drugs and medicines.....	283	0	0	0	0	0	0	0	0	0	0	(D)	0
Other chemicals.....	284-65, 287-99	0	0	0	0	0	0	0	(D)	0	0	(D)	0
Petroleum refining and extraction.....	13, 29	(D)	0	(D)	(D)	0	(D)	0	0	0	0	(D)	(D)
Rubber products.....	30	0	0	(D)	0	(D)	(D)	0	0	0	0	(D)	(D)
Stone, clay, and glass products.....	32	0	0	0	(D)	0	(D)	0	0	(D)	(D)	(D)	0
Primary metals.....	33	(1)	0	(D)	(D)	(D)	(D)	(D)	0	0	0	(D)	0
Ferrous metals and products.....	331-32, 3376-99	(D)	0	(D)	(D)	(D)	(D)	0	0	0	0	(D)	0
Nonferrous metals and products.....	333-34	(D)	0	(D)	(D)	(D)	(D)	0	0	0	0	(D)	0
Fabricated metal products.....	34	0	(D)	(D)	19	0	(D)	(D)	1	0	(D)	(D)	(D)
Machinery.....	35	142	118	252	66	3,963	51	0	(D)	0	(D)	(D)	(D)
Office, computing, and accounting machines.....	357	0	0	0	0	3,963	0	0	(D)	0	(D)	(D)	(D)
Other machinery, except electrical.....	351-36, 358-39	142	118	252	66	0	51	0	(D)	0	(D)	(D)	(D)
Electrical equipment.....	36	(D)	(D)	(D)	(D)	(D)	76	(D)	32	(D)	3,674	799	113
Radio and TV receiving equipment.....	363	0	0	0	0	0	0	0	0	0	(D)	0	0
Communication equipment.....	364	(D)	(D)	(D)	(D)	(D)	66	(D)	(D)	0	3,652	468	82
Electronic computers.....	365	0	0	0	0	0	(D)	(D)	0	0	(D)	265	(D)
Other electrical equipment.....	361-64, 366	(D)	0	0	(D)	(D)	(D)	26	18	0	(D)	26	(D)
Transportation equipment.....	37	(D)	(D)	51	(D)	(D)	(D)	34	(D)	(D)	464	2,071	216
Motor vehicles and motor vehicles equipment.....	371	(D)	2	(D)	(D)	(D)	(D)	(D)	(D)	0	(D)	(D)	(D)
Other transportation equipment.....	372-75, 379	(D)	(D)	(D)	0	(D)	(D)	0	0	0	(D)	(D)	0
Aircraft and missiles.....	372, 376	52	(D)	(D)	6	(D)	(D)	(D)	66	(D)	469	1,396	(D)
Professional and scientific instruments....	38	(D)	0	0	(D)	(D)	(D)	(D)	14	(D)	51	93	9
Scientific and mechanical measuring instruments.....	381-62	(D)	0	0	0	0	0	(D)	(D)	0	(D)	66	(D)
Optical, surveying, photographic, and other instruments.....	383-67	0	0	0	(D)	(D)	(D)	0	(D)	0	(D)	27	(D)
Other manufacturing industries.....	27, 31, 39	0	0	0	0	(D)	1,271	0	0	(D)	0	0	(D)
Nonmanufacturing industries.....	80, 81-12, 14-17, 80-87, 72-73, 804-97, 991	16	0	15	(D)	(D)	(D)	(D)	16	(D)	31	68	(D)

(D) Data have been withheld to avoid disclosing operations of individual companies.

(1) Data have been withheld due to imputation of 50 percent or more.

(1) Less than \$50,000.

NOTE: Imputation of R&D expenditures by product field was eliminated beginning in 1965. See Table D-20 for "coverage ratios."

SOURCE: National Science Foundation, NSD

Table B-29. Companies' own and Federal funds for industrial applied R&D performance by industry and secondary product field: 1987 (continued)

Industry	SIC Code	Transportation equipment			Professional and scientific instruments		
		Motor vehicles and equipment 371	Other transportation equipment 379	Aircraft and parts 372	Guided missiles and space-craft 376	Scientific and mechanical measuring instruments 381-82	Optical, surgical, photographic and other instruments 383-87
Total.....		\$4,009	\$137	\$7,513	\$4,832	\$609	\$350
Food, kindred, and tobacco products.....	20,21	0	0	0	0	0	0
Textiles and apparel.....	22,23	(D)	0	0	0	0	0
Lumber, wood products, and furniture.....	24,25	0	0	(D)	0	0	0
Paper and allied products.....	26	(D)	0	0	0	(D)	0
Chemicals and allied products.....	28	(D)	(D)	(D)	0	116	96
Industrial chemicals.....	281-82,286	0	0	(D)	0	(D)	(D)
Drugs and medicines.....	283	0	0	0	0	(D)	(D)
Other chemicals.....	284-85,287-89	(D)	(D)	0	0	(D)	(D)
Petroleum refining and extraction.....	13,29	(D)	(D)	0	0	(D)	(D)
Rubber products.....	30	0	0	0	(D)	(D)	0
Stone, clay, and glass products.....	32	(D)	(D)	(D)	(D)	(D)	(D)
Primary metals.....	33	(D)	(D)	(D)	(D)	12	(D)
Ferrous metals and products.....	331-32,3398-99	(D)	0	(D)	(D)	0	0
Nonferrous metals and products.....	333-36	(D)	(D)	(D)	0	12	(D)
Fabricated metal products.....	34	(D)	(D)	(D)	(D)	(D)	(D)
Machinery.....	35	20	(D)	(D)	0	(D)	(D)
Office, computing, and accounting machines.....	357	0	0	0	0	(D)	0
Other machinery, except electrical.....	351-36,358-59	20	(D)	(D)	0	(D)	(D)
Electrical equipment.....	36	(D)	1	76	(D)	92	18
Radio and TV receiving equipment.....	363	0	0	0	0	0	0
Communication equipment.....	366	(D)	(D)	(D)	(D)	(D)	(D)
Electronic components.....	367	0	0	0	(D)	24	(D)
Other electrical equipment.....	361-64,369	(D)	0	(D)	0	(D)	(D)
Transportation equipment.....	37	(D)	(D)	6,891	4,444	27	(D)
Motor vehicles and motor vehicles equipment.....	371	(D)	(D)	(D)	(D)	(D)	0
Other transportation equipment.....	373-75,379	(D)	(D)	(D)	(D)	0	0
Aircraft and missiles.....	372,376	(D)	(D)	6,697	3,812	(D)	(D)
Professional and scientific instruments....	38	(D)	(D)	(D)	(D)	297	101
Scientific and mechanical measuring instruments.....	381-82	(D)	(D)	(D)	0	(D)	(D)
Optical, surgical, photographic, and other instruments.....	383-87	(D)	0	0	(D)	(D)	(D)
Other manufacturing industries.....	27,31,39	0	0	0	0	0	0
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-87,891	(D)	(D)	58	(D)	(D)	(D)

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of 50 percent or more.

(1) Less than \$0.5 million.

NOTE: Imputation of R&D expenditures by product field was eliminated beginning in 1985. See Table B-28 for "coverage ratios."

SOURCE: National Science Foundation, SRS

Table B-30. Companies' own and Federal funds for industrial energy R&D performance by industry: 1972 and 1974-80 (projected)

[Dollars in millions]																	
Industry	SIC code	1972	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Pre- dicted 1988
Total.....		9750	81,399	81,774	92,073	12,373	92,965	93,643	94,162	94,216	94,240	94,345	94,446	93,954	93,358	93,482	93,979
Food, kindred, and tobacco products(t).....	20-21	(2)	(2)	(2)	(2)	(2)	(2)	(2)	4	5	(2)	(2)	(5)	2	2	(5)	(5)
Tobacco and apparel.....	22-23	8	8	0	1	(2)	(2)	(2)	(2)	(2)	(2)	(2)	2	1	(0)	(0)	(0)
Lumber, wood products, and furniture.....	24-25	(2)	(2)	(2)	(2)	(2)	(2)	(2)	3	4	5	5	5	3	(0)	(0)	(0)
Paper and allied products.....	26	(2)	(2)	(2)	(2)	1	2	3	3	2	3	3	6	(0)	(0)	1	1
Chemicals and allied products.....	28	52	71	102	121	140	157	220	257	312	347	345	191	112	(5)	(5)	(5)
Industrial chemicals.....	281-287,286	47	69	100	(2)	(2)	(2)	(2)	246	305	338	335	181	(0)	(0)	(0)	(0)
Drugs and medicines.....	283	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(0)	(0)	(0)	(0)	(0)
Other chemicals.....	284-285,287-89	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(0)	2	2	2	(5)
Petroleum refining and extraction.....	13,29	285	371	405	440	536	648	776	845	1,067	1,162	1,264	1,356	1,199	999	902	928
Other products.....	30	(2)	(2)	(2)	(2)	(2)	10	12	15	17	14	17	16	(0)	(0)	(0)	(0)
Blame, clay, and glass products.....	32	(2)	(2)	(2)	(2)	4	6	7	21	24	17	7	5	(0)	(0)	(0)	(0)
Primary metals.....	33	18	22	27	33	38	49	72	78	80	101	92	(5)	(5)	74	20	23
Primary metals and products.....	331-32,3390-99	(2)	(2)	(2)	12	19	14	19	20	20	22	35	35	26	(0)	(0)	(0)
Nonferrous metals and products.....	333-34	(2)	(2)	(2)	21	32	33	48	58	59	79	57	(0)	(5)	(0)	(0)	(0)
Fabricated metal products.....	34	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	54	31	(0)	8	(0)	(0)	(0)
Machinery.....	35	8	16	23	40	61	80	83	100	127	183	163	201	240	261	(5)	(5)
Office, computing, and accounting machin.....	357	(2)	(2)	(2)	(2)	(2)	(2)	13	17	6	16	(2)	(0)	12	(0)	(0)	(0)
Other machinery, except electrical.....	351-56,358-59	(2)	(2)	(2)	(2)	(2)	(2)	70	91	121	167	144	179	228	(0)	(0)	(0)
Electrical equipment.....	36	194	389	464	585	650	714	843	917	940	831	813	752	733	(0)	585	(0)
Radio and TV receiving equipment.....	365	0	8	0	0	0	0	0	3	(2)	5	0	8	0	0	0	0
Communication equipment.....	366	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	153	150	(0)	115	(0)	(0)	(0)
Electronic components.....	367	(2)	(2)	(2)	(2)	5	5	13	12	15	40	82	(0)	(0)	(0)	(0)	(0)
Other electrical equipment.....	361-64,369	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	631	501	610	(0)	(0)	(0)	(0)
Transportation equipment.....	37												(0)	(5)	(0)	(0)	(0)
Motor vehicles and other vehicles equipment.....	371	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(0)	(0)	(0)	(0)	(0)
Other transportation equipment.....	373-75,379	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	2	2	1	(0)	(0)	(0)	(0)
Aircraft and missiles.....	372,376	65	142	134	110	165	283	372	446	412	363	425	641	641	537	753	804
Professional and scientific instruments.....	38	12	14	14	10	17	27	28	45	53	54	45	36	(0)	(0)	(0)	(0)
Scientific and mechanical measuring instruments..	381-42	(2)	(2)	(2)	(2)	12	19	24	40	(2)	(2)	(2)	(0)	(0)	(0)	(0)	(0)
Optical, surgical, photographic, and other instruments.....	383-47	(2)	(2)	(2)	(2)	5	8	4	5	(2)	(2)	(2)	(0)	(0)	0	0	0
Other manufacturing industries.....	27,31,39	(2)	(2)	(2)	(2)	4	7	7	19	(2)	12	17	12	0	0	0	0
Nonmanufacturing industries.....	80,10-12,14-17, 40-47,72-75, 800-87,891	76	100	90	137	185	220	324	333	374	375	349	424	338	328	332	353

(1) Both 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

(2) Not separately available but included in total. See parent table.

(3) Data have been withheld to avoid disclosing operations of individual companies.

(4) Data have been withheld due to imputation of more than 50 percent.

Table 8-31. Companies' own funds for industrial energy R&D performance by selected industry: 1974-87

		[Dollars in millions]													
Industry	SIC code	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	
Total.....		\$857	\$1,152	\$1,319	\$1,632	\$1,796	\$2,230	\$2,599	\$2,680	\$2,762	\$2,842	\$2,962	\$2,537	\$2,167	
Chemicals and allied products.....	28	(1)	(1)	(1)	(1)	(1)	(1)	(1)	149	178	166	169	(D)	(D)	
Petroleum refining and extraction.....	13,29	(1)	(1)	(1)	469	530	623	699	957	1,096	1,218	(D)	1,145	957	
Machinery.....	35											(D)	(D)	(D)	
Electrical equipment.....	36	96	115	122	165	137	219	205	203	146	132	123	71	(D)	
Aircraft and missiles.....	372,376	(1)	(1)	(1)	57	68	113	163	124	99	(1)	190	264	236	
All other manufacturing industries.....		(1)	(1)	(1)	(1)	(1)	(1)	(1)	1,053	1,079	(1)	779	610	497	
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	48	31	66	75	82	141	154	194	164	143	189	84	(D)	

(1) Not separately available but included in total. See general notes.

(D) Data have been withheld to avoid disclosing operations of individual companies.

(5) Data have been withheld due to imputation of more than 50 percent.

SOURCE: National Science Foundation, SRS

Table 8-32. Federal funds for industrial energy R&D performance by selected industry: 1974-87

		[Dollars in millions]													
Industry	SIC code	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total.....		\$482	\$622	\$754	\$941	\$1,169	\$1,413	\$1,563	\$1,536	\$1,478	\$1,503	\$1,484	\$1,417	\$1,191	\$1,142
Chemicals and allied products.....	28	(1)	(1)	(1)	(1)	(1)	(1)	(1)	163	169	179	22	(D)	(D)	(D)
Petroleum refining and extraction.....	13,29	(2)	(2)	(2)	67	118	153	146	110	66	66	(D)	54	42	3
Machinery.....	35											(D)	(D)	(D)	(D)
Electrical equipment.....	36	293	349	463	485	577	624	711	705	685	681	629	662	(D)	(D)
Aircraft and missiles.....	372,376	(2)	(2)	(2)	108	215	259	283	288	264	(1)	471	417	302	347
All other manufacturing industries.....		(2)	(2)	(2)	(2)	(1)	(1)	(1)	90	83	(1)	52	13	4	4
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	52	67	71	110	139	183	179	180	211	206	235	254	(D)	234

(1) Not separately available but included in total. See general notes.

(2) Less than \$0.5 million.

(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-33. Companies' own and Federal funds for industrial energy R&D performance by primary energy source: 1973-88 (projected)

Primary energy source	[Dollars in millions]														Pro- jected 1988
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total.....	\$1,009	\$1,339	\$1,774	\$2,073	\$2,573	\$2,965	\$3,643	\$4,162	\$4,216	\$4,240	\$4,345	\$4,446	\$3,954	\$3,358	\$3,482
Fossil fuels.....	438	516	550	605	757	843	1,063	1,228	1,437	1,491	1,573	1,738	1,876	1,476	1,520
Oil.....	297	329	333	381	449	(1)	557	(1)	772	(1)	905	(1)	1,395	(1)	(S)
Gas.....	51	74	66	68	93	(1)	113	(1)	208	(1)	255	(1)	189	(1)	191
Shale.....	12	18	19	24	35	(1)	24	(1)	57	(1)	48	(1)	125	(1)	11
Coal.....	49	65	109	127	175	(1)	313	(1)	383	(1)	(2)	(1)	150	(1)	46
Synthetic fossil fuels.....	(1)	21	50	74	115	(1)	236	(1)	210	(1)	(2)	(1)	111	(1)	23
Mining.....	(1)	5	9	10	9	(1)	1	(1)	31	(1)	(2)	(1)	8	(1)	3
Other.....	(1)	39	50	43	51	(1)	76	(1)	142	(1)	(2)	(1)	31	(1)	(S)
Other fossil fuels	29	30	23	5	5	(1)	56	(1)	17	(1)	(2)	(1)	17	(1)	51
Nuclear.....	501	601	700	799	926	995	1,037	1,056	1,037	1,078	1,118	1,113	1,212	979	906
Fission.....	476	567	659	741	844	(1)	913	(1)	866	(1)	973	(1)	1,062	(1)	858
Fusion.....	25	34	41	58	82	(1)	124	(1)	171	(1)	145	(1)	150	(1)	(S)
Total geothermal, solar, conservation, and utilization....	3	146	460	584	775	(1)	1,156	(1)	774	(1)	1,424	1,218	471	504	393
Geothermal.....	1	2	6	13	24	(1)	149	(1)	71	(1)	(2)	(1)	54	(1)	38
Solar.....	2	7	19	43	64	(1)	321	(1)	298	(1)	(2)	(1)	96	(1)	85
Conservation and utilization.....	(1)	137	435	528	687	(1)	686	(1)	405	(1)	(2)	(1)	321	(1)	270
All other energy....	67	76	64	85	115	(1)	387	(1)	968	(1)	230	377	395	399	(S)

(S) Data have been withheld due to imputation of more than 50 percent

(1) Data not collected.

(2) Not separately available, but included in total. See general notes.

Notes: Detailed data for 1977, 1979, 1981, 1983, and 1985 were estimated based upon (a) data actually reported in those years, (b) revised data for those years which were reported on the 1978, 1980, 1982, 1984, and 1986 survey forms, and (c) adjustments due to new samples in 1981 and 1987.

SOURCE: National Science Foundation, SRS

Table B-34. Companies' own funds for industrial energy R&D performance by primary energy source: 1974-88 (projected)

Primary energy source	[Dollars in millions]														Projected 1988
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	
Total.....	\$857	\$1,152	\$1,316	\$1,632	\$1,796	\$2,230	\$2,599	\$2,680	\$2,762	\$2,842	\$2,962	\$2,537	\$2,167	\$2,340	\$2,420
Fossil fuels.....	503	507	523	644	678	788	993	1,257	1,361	1,455	1,509	1,797	(D)	1,459	(S)
Oil.....	326	327	369	436	(1)	529	(1)	746	(1)	(2)	(1)	1,381	(1)	(S)	(S)
Gas.....	(2)	(2)	52	73	(1)	109	(1)	(2)	(1)	(2)	(1)	(D)	(1)	(D)	(S)
Shale.....	(2)	(2)	(2)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	124	(1)	(D)	(S)
Coal.....	56	77	80	98	(1)	130	(1)	244	(1)	(2)	(1)	(S)	(1)	29	48
Synthetic fossil fuels...	(2)	(2)	48	64	(1)	84	(1)	132	(1)	(2)	(1)	91	(1)	15	(S)
Mining.....	(2)	(2)	7	5	(1)	1	(1)	24	(1)	(2)	(1)	8	(1)	(D)	(D)
Other.....	33	34	25	29	(1)	45	(1)	89	(1)	(2)	(1)	(S)	(1)	(D)	(D)
Other fossil fuels.....	(2)	(2)	(2)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	17	(1)	50	(S)
Nuclear.....	157	160	198	217	217	169	150	126	99	90	101	150	91	85	86
Fission.....	146	156	194	211	(1)	167	(1)	70	(1)	71	(1)	135	(1)	81	82
Fusion.....	11	4	4	6	(1)	2	(1)	56	(1)	19	(1)	15	(1)	(S)	(S)
Total geothermal, solar, conservation, and utilization.....	(2)	(2)	533	387	(1)	1,054	(1)	573	(1)	1,147	1,086	313	(D)	275	210
Geothermal.....	(2)	(2)	5	9	(1)	122	(1)	40	(1)	(2)	(1)	27	(1)	(D)	(D)
Solar.....	(2)	(2)	17	22	(1)	251	(1)	199	(1)	(2)	(1)	51	(1)	48	41
Conservation and utilization.....	129	425	511	656	(1)	681	(1)	334	(1)	(2)	(1)	235	(1)	(D)	(D)
All other energy.....	62	46	62	83	(1)	219	(1)	724	(1)	150	267	277	(D)	(S)	(S)

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of more than 50 percent.

(1) Data not collected.

(2) Not separately available but included in total. See general notes.

Note: Data for 1973-1976 were revised by National Science Foundation staff. Detailed data for 1977, 1979, 1981, 1983, and 1985 were estimated on the basis of

(a) data actually reported in those years, (b) revised data for those years reported on the 1978, 1980, 1982, 1984, and 1986 survey forms, and (c) adjustments due to new samples in 1981 and 1987.

Table B-35. Federal funds for industrial energy R&D performance by primary energy source: 1974-88 (projected)

Primary energy source	[Dollars in millions]															Pro- jected 1988
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987		
Total.....	\$482	\$622	\$757	\$941	\$1,169	\$1,413	\$1,563	\$1,536	\$1,478	\$1,503	\$1,484	\$1,417	\$1,191	\$1,142	\$1,259	
Fossil fuels.....	13	43	82	113	165	275	235	180	130	117	228	78	(D)	62	(S)	
Oil.....	3	6	12	13	(1)	29	(1)	26	(1)	(2)	(1)	13	(1)	(S)	(S)	
Gas.....	(2)	(2)	16	20	(1)	4	(1)	(2)	(1)	10	(1)	(D)	(1)	(D)	(S)	
Shale.....	(2)	(2)	(2)	(2)	(1)	(2)	(1)	(2)	(1)	1	(1)	1	(1)	(D)	(S)	
Coal.....	9	32	47	77	(1)	183	(1)	139	(1)	76	(1)	(S)	(1)	17	37	
Synthetic fossil fuels...	(2)	(2)	26	51	(1)	152	(1)	78	(1)	(2)	(1)	20	(1)	8	(S)	
Mining.....	(2)	(2)	3	4	(1)	0	(1)	7	(1)	(2)	(1)	0	(1)	(D)	(D)	
Other.....	6	16	18	22	(1)	31	(1)	53	(1)	(2)	(1)	(S)	(1)	(D)	(D)	
Other fossil fuels.....	(2)	(2)	(2)	(2)	(1)	(2)	(1)	(2)	(1)	16	(1)	0	(1)	1	(S)	
Nuclear.....	444	540	601	709	778	868	906	911	979	1,029	1,013	1,063	888	821	880	
Fission.....	421	503	547	633	(1)	746	(1)	796	(1)	902	(1)	928	(1)	777	835	
Fusion.....	23	37	54	76	(1)	122	(1)	115	(1)	127	(1)	135	(1)	(S)	(S)	
Total geothermal, solar, conservation, and utilization.....	(2)	(2)	51	88	(1)	102	(1)	201	(1)	277	132	158	(D)	117	140	
Geothermal.....	(2)	(2)	8	15	(1)	27	(1)	31	(1)	(2)	(1)	26	(1)	(D)	(D)	
Solar.....	(2)	(2)	26	42	(1)	70	(1)	99	(1)	(2)	(1)	45	(1)	37	33	
Conservation and utilization.....	8	10	17	31	(1)	5	(1)	71	(1)	80	(1)	87	(1)	(D)	(D)	
All other energy.....	14	18	23	32	(1)	168	(1)	244	(1)	80	110	118	(D)	142	142	

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of more than 50 percent.

(1) Data not collected.

(2) Not separately available but included in total. See general notes.

Note: Data for 1974-1976 were revised by National Science Foundation staff. Detailed data for 1977, 1979, 1981, 1983, and 1985 were estimated on the basis of

(a) data actually reported in those years, (b) revised data for those years reported on the 1978, 1980, 1982, 1984, and 1986 survey forms, and (c) adjustments due to new samples in 1981 and 1987.

SOURCE: National Science Foundation, SRS

Table 8-36. Companies' own and Federal funds for industrial pollution abatement
R&D performance by industry: 1974-88 (projected)

		[Dollars in millions]															Pro- jected 1988
Industry	SIC code	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987		
Total.....		\$657	\$647	\$754	\$901	\$1,065	\$1,249	\$1,202	(S)	(S)	(S)	\$1,060	(S)	(S)	(S)	(S)	
Food, kindred, and tobacco products(1).....	20,21	3	3	3	3	2	2	3	1	1	9	12	1	1	1	1	
Textiles and apparel.....	22,23	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(S)	(3)	(D)	(D)	(D)	
Lumber, wood products, and furniture.....	24,25	5	4	4	5	3	3	4	5	3	2	(D)	1	(D)	(D)	(D)	
Paper and allied products.....	26	4	5	6	6	8	(2)	(2)	(2)	9	6	7	8	7	7	7	
Chemicals and allied products.....	28	61	71	72	82	79	146	178	186	191	167	158	(S)	168	120	156	
Industrial chemicals.....	281-82,286	39	56	58	64	67	128	157	165	173	144	140	(S)	(S)	101	110	
Drugs and medicines.....	283	(2)	(2)	(2)	(2)	(2)	4	4	6	6	11	8	(D)	(D)	(D)	(D)	
Other chemicals.....	284-85,287-89	(2)	(2)	(2)	(2)	(2)	13	16	15	12	12	10	14	(D)	(D)	(D)	
Petroleum refining and extraction.....	13,29	61	65	58	60	71	80	95	92	97	81	88	60	63	48	55	
Rubber products.....	30	0	2	2	2	3	3	3	(2)	2	1	(D)	(D)	(D)	(D)	(D)	
Stone, clay, and glass products.....	32	7	5	4	6	7	9	11	9	7	9	(S)	3	4	(D)	(D)	
Primary metals.....	33	13	24	31	29	25	29	30	24	22	21	21	20	8	5	6	
Ferrous metals and products.....	331-32,3398-99	11	17	19	18	13	14	14	15	13	10	13	11	2	2	(S)	
Nonferrous metals and products.....	333-36	3	7	12	12	12	15	15	9	9	11	8	9	6	(D)	4	
Fabricated metal products.....	34	(2)	(2)	(2)	(2)	(2)	6	7	3	11	7	14	6	(D)	(D)	(D)	
Machinery.....	35	25	23	29	32	38	31	30	34	30	27	26	26	33	9	9	
Office, computing, and accounting machines	357	0	0	0	0	0	0	1	0	0	0	(D)	0	0	0	0	
Other machinery, except electrical.....	351-56,358-59	25	23	29	31	37	30	29	34	30	27	(D)	26	33	9	9	
Electrical equipment.....	36	16	19	18	20	19	34	39	39	24	18	(D)	(D)	5	(D)	(D)	
Radio and TV receiving equipment.....	365	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Communication equipment.....	366	(2)	(2)	5	6	6	5	6	(2)	(2)	(2)	(D)	1	1	2	1	
Electronic components.....	367	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(S)	(3)	(D)	(D)	(D)	
Other electrical equipment.....	361-64,369		(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	12	(D)	(D)	(D)	(D)	(D)	
Transportation equipment.....	37											(S)	(S)	(S)	(S)	(S)	
Motor vehicles & motor vehicles equipment.	371	384	347	413	487	593	(2)	(2)	(2)	(2)	(2)	(D)	(D)	(D)	(D)	(D)	
Other transportation equipment.....	373-75,379	(2)	(2)	(2)	(2)	(2)	0	(2)	0	0	(2)	(D)	(D)	(D)	(D)	(D)	
Aircraft and missiles.....	372,376	38	36	48	57	64	64	38	30	(2)	(2)	(D)	(S)	87	122	118	
Professional and scientific instruments.....	38	(2)	(2)	(2)	3	4	3	(2)	(2)	(2)	3	2	2	(D)	(D)	(D)	
Scientific and mechanical measuring instruments.....	381-82	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	1	(D)	(D)	(D)	(D)	(D)	
Optical, surgical, photographic, and other instruments.....	383-87	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	2	(D)	(D)	(D)	(D)	(D)	
Other manufacturing industries.....	27,31,39	2	1	2	3	3	2	3	(2)	(2)	2	3	(S)	0	0	0	
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	29	34	55	61	102	104	79	77	65	124	113	118	80	105	140	

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of more than 50 percent.

(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

(2) Not separately available but included in total. See general notes.

(3) Less than \$0.5 million.

SOURCE: National Science Foundation, SRS

Table B-37. Companies' own funds for industrial pollution abatement
R&D performance by selected industry: 1974-87

[Dollars in millions]															
Industry	SIC code	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total.....		\$606	\$606	\$708	\$861	(1)	\$1,139	\$1,095	(S)	(S)	(S)	(S)	(S)	(S)	(S)
Chemicals and allied products.....	28	(2)	(2)	57	64	(1)	113	130	128	123	101	(D)	(S)	(D)	(D)
Petroleum refining and extraction.....	13,29	59	64	59	82	(1)	(2)	93	92	97	82	(D)	61	63	48
Machinery.....	35											(D)	(D)	33	9
Electrical equipment.....	36	(2)	(2)	11	11	(1)	17	19	19	12	13	(D)	(D)	(D)	(D)
Aircraft and missiles.....	372,376	13	29	37	49	(1)	(2)	26	20	22	17	24	(D)	(D)	61
All other manufacturing industries.....		(2)	(2)	494	573	(1)	(2)	705	(2)	(2)	(2)	565	(D)	676	621
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	(2)	(2)	50	82	(1)	98	63	39	38	51	47	(D)	(D)	(D)

Data have been withheld to avoid disclosing operations of individual companies.

Data have been withheld due to imputation of 50 percent or more.

Data not available for 1978.

Not separately available but included in total. See general notes.

SOURCE: National Science Foundation, SRS

Table B-38. Federal funds for industrial pollution abatement
R&D performance by selected industry: 1974-87

[Dollars in millions]															
Industry	SIC code	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total.....		\$51	\$41	\$51	\$57	(1)	\$98	\$107	\$129	\$122	\$176	\$169	\$169	\$148	\$186
Chemicals and allied products.....	28	(2)	(2)	15	20	(1)	36	48	58	68	66	(D)	(D)	(D)	(D)
Petroleum refining and extraction.....	13,29	2	1	4	6	(1)	(2)	2	0	0	0	(D)	0	0	0
Machinery.....	35											(D)	(D)	0	0
Electrical equipment.....	36	(2)	(2)	7	8	(1)	17	20	20	12	5	(D)	(D)	(D)	(D)
Aircraft and missiles.....	372,376	21	7	11	8	(1)	(2)	12	10	(2)	(2)	(D)	(D)	(D)	61
All other manufacturing industries.....		(2)	(2)	12	8	(1)	(2)	6	3	(2)	(2)	(D)	(D)	921	1,273
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	(2)	(2)	2	7	(1)	15	16	38	26	74	67	(D)	(D)	(D)

(D) Data have been withheld to avoid disclosing information about individual companies.

(1) Data not available for 1978.

(2) Not separately available but included in total. See general notes.

SOURCE: National Science Foundation, SRS

Table B-39. Companies' own and Federal funds for industrial pollution abatement
R&D performance by type of pollution: 1973-88 (projected)

[Dollars in millions]																
Type of pollution	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Pro- jected 1988
Total.....	\$603	\$657	\$647	\$754	\$901	\$1,065	\$1,249	\$1,202	(\$)	(\$)	(\$)	\$1,060	(\$)	(\$)	(\$)	(\$)
Air.....	461	508	478	569	676	(1)	954	(1)	(\$)	(1)	(\$)	(1)	(\$)	(1)	(\$)	(\$)
Automotive emission.....	(1)	383	348	426	495	(1)	736	(1)	(\$)	(1)	(\$)	(1)	(0)	(1)	(\$)	(\$)
Electric power plant emissions.....	(1)	25	28	31	67	(1)	70	(1)	27	(1)	23	(1)	12	(1)	16	(\$)
All other.....	(1)	100	102	112	114	(1)	148	(1)	112	(1)	91	(1)	(0)	(1)	(\$)	(\$)
Water.....	76	60	71	84	97	(1)	120	(1)	105	(1)	124	(1)	(\$)	(1)	(\$)	(\$)
Solid waste.....	10	14	23	21	28	(1)	44	(1)	96	(1)	108	(1)	(\$)	(1)	206	233
Other.....	56	75	75	80	100	(1)	131	(1)	65	(1)	54	(1)	108	(1)	90	118

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of 50 percent or more.

(1) Data not collected.

Note: Detailed data for 1977, 1979, 1981, 1983, and 1985 were estimated based upon (a) data actually reported in those years, (b) revised totals for those years which were reported on the 1978, 1980, 1982, 1984, and 1986 survey forms, and (c) adjustments due to new samples in 1981 and 1987.

SOURCE: National Science Foundation, SRS

Table B-40. Industrial expenditures for pollution abatement research and
development by type of pollution and source of funds: 1984-87

[Dollars in millions]												
Type of pollution	1984			1985			1986			1987		
	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
Total.....	\$1,060	\$169	(S)	(S)	\$169	(S)	(S)	\$148	(S)	(S)	\$186	(S)
Air.....	(1)	(1)	(1)	(S)	12	(S)	(1)	(1)	(1)	(S)	(S)	(S)
Automotive emission.....	(1)	(1)	(1)	(D)	(D)	(S)	(1)	(1)	(1)	(S)	(D)	(D)
Electric power plant emissions.....	(1)	(1)	(1)	12	5	7	(1)	(1)	(1)	16	(D)	(D)
All other.....	(1)	(1)	(1)	(D)	(D)	(S)	(1)	(1)	(1)	(S)	(S)	(S)
Water.....	(1)	(1)	(1)	(S)	15	(S)	(1)	(1)	(1)	(S)	(D)	(D)
Solid waste.....	(1)	(1)	(1)	(S)	117	(S)	(1)	(1)	(1)	206	104	162
Other.....	(1)	(1)	(1)	108	26	82	(1)	(1)	(1)	90	(D)	(D)

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of 50 percent or more.

(1) Data not collected.

SOURCE: National Science Foundation, SRS

Table B-41. Geographic distribution of (company and Federal) foods for industrial R&D performance: 1963, 1966-77, 1979, 1981, 1983, 1985, and 1987

		[Dollars in millions]																		
Area		1963	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1979	1981	1983	1985	1987	
United States.....		912,630	915,348	916,385	917,429	918,308	918,067	918,320	919,552	921,249	922,087	924,187	926,997	929,825	938,226	951,810	965,694	985,610	996,305	
Northeast.....		3,818	5,092	5,438	5,867	6,095	6,333	6,510	6,869	6,735	7,291	7,403	8,096	8,687	10,296	14,171	18,737	23,058	25,654	
New England.....		993	1,494	1,661	1,870	1,835	1,854	1,884	1,929	2,011	2,058	2,029	2,147	2,400	3,003	4,216	5,156	6,922	8,324	
Maine.....		4	5	8	9	6	10	9	10	8	9	21	24	40	(0)	(0)	(0)	(0)	41	
New Hampshire.....		6	27	49	43	49	49	52	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(0)	(0)	94	
Vermont.....		6	15	14	20	32	34	61	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(0)	(0)	247	
Massachusetts.....		481	826	915	986	977	1,004	1,082	1,141	1,135	1,080	1,022	1,156	1,349	1,690	2,223	2,775	4,173	5,492	
Rhode Island.....		7	9	14	17	45	52	51	43	44	41	45	22	24	49	98	169	198	234	
Connecticut.....		489	612	663	795	726	705	629	637	732	821	832	815	876	985	1,571	1,864	1,976	2,216	
Middle Atlantic.....		2,825	3,598	3,777	3,997	4,260	4,479	4,626	4,940	4,724	5,233	5,374	5,949	6,287	7,293	9,955	13,581	16,136	17,330	
New York.....		1,176	1,573	1,718	1,830	1,981	2,038	2,066	2,201	1,971	2,134	2,225	2,418	2,542	2,959	3,490	4,866	7,019	6,559	
New Jersey.....		958	1,119	1,098	1,117	1,202	1,292	1,403	1,358	1,407	1,512	1,547	1,717	1,900	2,191	3,354	4,655	5,547	6,141	
Pennsylvania.....		691	906	911	1,050	1,077	1,149	1,157	1,181	1,347	1,537	1,602	1,814	1,845	2,143	3,111	4,060	3,570	4,630	
North Central.....		2,791	3,382	3,638	3,766	4,216	4,393	4,849	5,414	5,468	5,756	5,821	6,574	7,777	10,013	11,781	14,585	18,001	24,224	
East North Central.....		2,230	2,857	3,157	3,291	3,570	3,624	3,837	4,314	4,424	4,704	4,816	5,390	6,270	8,065	9,294	11,481	14,161	18,429	
Ohio.....		583	774	879	910	925	982	945	984	1,043	1,103	1,139	1,183	1,323	1,635	1,581	2,544	2,847	3,549	
Indiana.....		236	316	377	386	431	428	448	459	387	403	453	469	541	723	956	1,107	1,433	1,944	
Illinois.....		398	539	612	625	680	731	796	855	862	970	1,042	1,226	1,360	1,673	2,073	2,689	3,231	4,284	
Michigan.....		862	1,049	1,089	1,162	1,305	1,259	1,413	1,733	1,883	2,016	1,961	2,249	2,750	3,614	4,029	4,477	5,975	7,415	
Wisconsin.....		149	179	201	208	229	224	235	283	249	212	221	263	296	420	655	664	676	1,217	
West North Central.....		562	525	480	475	646	749	1,012	1,100	1,044	1,052	1,005	1,184	1,507	1,948	2,487	3,104	3,840	5,795	
Minnesota.....		149	225	239	250	298	289	294	332	341	411	403	551	602	802	1,019	1,477	1,971	2,242	
Iowa.....		58	103	75	71	87	138	138	136	158	175	182	144	173	150	334	322	317	343	
Missouri.....		304	156	125	99	211	(1)	(1)	569	484	399	350	398	630	746	901	818	1,208	1,905	
North Dakota.....		0	0	0	0	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(0)	10	60	
South Dakota.....		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(0)	7	4	
Nebraska.....		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(0)	24	42	
Kansas.....		47	30	34	45	41	50	36	49	49	51	60	76	84	216	218	368	285	1,179	
South.....		1,701	2,437	2,414	2,531	2,488	2,341	2,472	2,450	2,601	2,891	2,964	3,442	3,691	4,496	7,251	9,297	12,020	16,456	
South Atlantic.....		931	1,179	1,220	1,304	1,466	1,424	1,612	1,546	1,666	1,775	1,720	1,847	2,012	2,592	3,933	4,726	6,812	9,208	
Delaware.....		26	41	37	26	34	51	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(0)	(0)	(0)	
Maryland.....		241	275	254	310	301	361	369	386	423	481	446	452	382	424	525	547	1,437	1,350	
District of Columbia.....		12	19	23	47	30	31	21	24	10	24	14	8	33	(0)	(0)	(0)	(0)	(0)	
Virginia.....		93	(1)	(1)	(1)	(1)	(1)	133	131	194	244	236	264	318	464	523	845	800	1,342	
West Virginia.....		89	59	63	61	54	48	40	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(0)	(0)	87	
North Carolina.....		71	124	120	138	157	175	140	143	203	227	235	253	268	327	508	754	797	1,741	
South Carolina.....		20	47	48	51	59	65	(1)	58	38	30	37	87	96	82	136	149	389	523	
Georgia.....		61	(1)	(1)	(1)	(1)	(1)	122	91	73	83	81	91	99	147	287	342	515	1,001	
Florida.....		284	338	375	436	424	371	422	353	386	374	348	398	462	620	1,404	1,347	1,832	2,133	
East South Central.....		280	487	473	416	364	346	342	327	356	388	401	427	467	402	955	1,221	1,209	2,334	
Kentucky.....		22	41	48	51	53	55	52	61	73	67	74	79	100	209	(0)	(0)	221	249	
Tennessee.....		139	206	221	199	194	183	191	181	190	231	261	282	306	(1)	452	495	538	649	
Alabama.....		116	238	203	164	114	105	96	81	84	79	57	56	48	62	144	299	387	1,592	
Mississippi.....		2	2	2	2	3	3	3	4	8	8	10	10	13	(1)	(0)	(0)	62	44	
West South Central.....		491	771	721	811	658	571	519	577	579	728	843	1,113	1,212	1,502	2,363	3,350	3,998	4,914	
Arkansas.....		2	5	5	6	5	7	5	5	4	9	13	12	10	11	8	5	15	135	
Louisiana.....		131	237	154	127	103	58	51	64	55	74	88	98	106	83	152	229	187	134	
Oklahoma.....		53	99	83	71	73	81	63	82	72	76	99	116	142	174	243	337	304	384	
Texas.....		304	430	479	607	477	445	400	424	448	567	643	887	954	1,233	1,940	2,771	3,492	4,261	
West.....		4,320	4,635	4,897	5,264	5,509	5,000	4,489	4,819	5,275	5,620	6,165	6,055	7,379	10,176	15,124	18,887	23,738	27,387	
Montana.....		465	446	489	596	651	687	570	576	621	622	782	923	1,034	1,139	2,246	2,903	3,496	4,464	
Nebraska.....		(1)	(1)	(1)	(1)	0	8	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(0)	(0)	7	
Idaho.....		27	(1)	(1)	(1)	(1)	(1)	30	(1)	(1)	(1)	(1)	(1)	(1)	(1)	244	303	419	488	
Wyoming.....		1	2	2	2	3	3	5	(1)	(1)	(1)	(1)	(1)	(1)	(1)	4	2	3	4	
Colorado.....		126	108	119	139	149	217	140	130	146	166	194	250	257	269	496	776	917	1,261	
New Mexico.....		(1)	146	154	151	179	179	(1)	163	149	(1)	(1)	(1)	(1)	(1)	(0)	(0)	(0)	993	
Arizona.....		86	116	125	180	197	152	155	171	212	199	243	203	200	372	728	895	1,002	845	
Utah.....		71	18	21	21	25	22	17	26	43	61	91	112	132	142	(0)	247	317	809	
Nevada.....		(1)	38	52	55	37	37	(1)	(1)	(1)	8	11	35	72	(1)	(0)	(0)	(0)	57	
Pacific.....		3,854	4,189	4,407	4,668	4,858	4,313	3,919	4,243	4,654	4,958	5,384	5,932	6,345	9,037	12,878	15,984	20,242	22,923	
Washington.....		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	484	499	610	681	(1)	1,413	2,183	3,071	
Oregon.....		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	50	51	57	77	116	(0)	(0)	285	294	
California.....		3,512	(1)	(1)	(1)	(1)	3,800	3,460	3,710	4,241	4,423	4,834	5,263	5,600	7,437	10,765	14,237	17,760	19,475	
Alaska.....		0	0	0	0	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(0)	(0)	10	
Hawaii.....		(1)	(1)	(1)	(1)	(1)	(1)	3	2	2	1	(1)	(1)	(1)	(1)	(0)	(0)	(0)	73	
Undistributed foods.....		(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	1,146	1,302	1,803	2,030	2,291	3,245	3,483	4,188	8,793	2,384	

(1) Not separately available but included in total. See general notes.

(2) Data have been withheld to avoid disclosing operations of individual companies.

NOTE: A new sample was drawn for 1987 (see Section A, Technical Notes), and totals for 1983 and 1985 were revised based on data obtained for 1987. Data for individual states, however, were not adjusted. The differences, \$2,291 million and \$7,402 million, were added to the "undistributed foods"

Table B-42. Geographic distribution of funds for industrial
R&D performance by source of funds: 1987

Area	[Dollars in millions]		
	Total	Federal	Company
United States.....	\$96,305	\$31,403	\$64,902
Northeast.....	25,654	5,649	20,005
New England.....	8,324	2,223	6,101
Maine.....	41	0	41
New Hampshire.....	94	(D)	(D)
Vermont.....	247	0	247
Massachusetts.....	5,492	1,468	4,024
Rhode Island.....	234	(D)	(D)
Connecticut.....	2,216	632	1,584
Middle Atlantic.....	17,330	3,426	13,904
New York.....	6,559	1,589	4,970
New Jersey.....	6,141	457	5,684
Pennsylvania.....	4,630	1,380	3,250
North Central.....	24,224	3,797	20,427
East North Central.....	18,429	2,206	16,223
Ohio.....	3,569	762	2,807
Indiana.....	1,944	353	1,591
Illinois.....	4,284	940	3,344
Michigan.....	7,415	115	7,300
Wisconsin.....	1,217	36	1,181
West North Central.....	5,795	1,591	4,204
Minnesota.....	2,242	(D)	(D)
Iowa.....	343	(D)	(D)
Missouri.....	1,905	(D)	(D)
North Dakota.....	60	(D)	(D)
South Dakota.....	4	0	4
Nebraska.....	62	(D)	(D)
Kansas.....	1,179	(D)	(D)
South.....	16,656	6,078	10,578
South Atlantic.....	9,208	2,923	6,285
Delaware.....	(D)	(D)	(D)
Maryland.....	1,350	608	742
District of Columbia.....	(D)	(D)	(D)
Virginia.....	1,342	1,068	274
West Virginia.....	87	(D)	(D)
North Carolina.....	1,741	5	1,736
South Carolina.....	523	(D)	(D)
Georgia.....	1,001	(D)	(D)
Florida.....	2,133	892	1,241
East South Central.....	2,534	1,262	1,272
Kentucky.....	249	(D)	(D)
Tennessee.....	649	(D)	(D)
Alabama.....	1,592	900	692
Mississippi.....	44	(D)	(D)
West South Central.....	4,914	1,893	3,021
Arkansas.....	135	(D)	(D)
Louisiana.....	134	(D)	(D)
Oklahoma.....	384	(D)	(D)
Texas.....	4,261	1,784	2,477
West.....	27,387	14,997	12,390
Mountain.....	4,464	2,218	2,246
Montana.....	7	0	7
Idaho.....	488	386	102
Wyoming.....	4	0	4
Colorado.....	1,261	282	979
New Mexico.....	993	906	87
Arizona.....	845	178	667
Utah.....	809	(D)	(D)
Nevada.....	57	(D)	(D)
Pacific.....	22,923	12,779	10,144
Washington.....	3,071	(D)	(D)
Oregon.....	294	(D)	(D)
California.....	19,475	10,963	8,512
Alaska.....	10	(D)	(D)
Hawaii.....	73	54	19
Undistributed funds.....	2,384	882	1,502

(D) Data have been withheld to avoid disclosing operations of individual companies.

SOURCE: National Science Foundation, SRS

Table B-43. Distribution of companies' own and Federal R&D funds by industry and type of cost: 1987

[Percent]					
Industry	SIC Code	R & D costs	Wages of R & D personnel	Materials and supplies	Overhead costs
Total.....	.....	\$96,305	41.6	17.9	40.5
Food, kindred, and tobacco products.....	20,21	1,402	49.6	13.1	37.3
Textiles and apparel.....	22,23	(D)	50.4	20.6	29.0
Lumber, wood products, and furniture.....	24,25	140	60.0	15.0	25.0
Paper and allied products.....	26	(D)	56.8	15.5	27.7
Chemicals and allied products.....	28	9,831	43.6	11.6	44.8
Industrial chemicals.....	281-82,286	3,879	41.3	11.8	46.9
Drugs and medicines.....	283	(D)	45.2	12.4	42.4
Other chemicals.....	284-85,287-89	(D)	44.5	9.2	46.3
Petroleum refining and extraction.....	13,29	1,899	42.2	10.7	47.1
Rubber products.....	30	(D)	42.4	22.8	34.8
Stone, clay, and glass products.....	32	1,024	44.6	17.9	37.5
Primary metals.....	33	(D)	39.3	7.7	53.0
Ferrous metals and products.....	331-32,3398-99	(D)	38.8	5.1	56.1
Nonferrous metals and products.....	333-36	452	40.3	13.1	46.6
Fabricated metal products.....	34	1,120	49.1	17.4	33.5
Machinery.....	35	(D)	46.1	13.1	40.8
Office, computing, and accounting machines.....	357	(D)	45.2	12.9	41.9
Other machinery, except electrical.....	351-56,358-59	2,960	49.2	13.8	37.0
Electrical equipment.....	36	16,920	35.8	19.5	44.7
Radio and TV receiving equipment.....	365	143	58.7	15.4	25.9
Communication equipment.....	366	9,538	32.6	19.3	48.1
Electronic components.....	367	(D)	46.2	18.8	35.0
Other electrical equipment.....	361-64,369	(D)	30.3	21.4	48.3
Transportation equipment.....	37	33,393	39.3	24.1	36.6
Motor vehicles and motor vehicles equipment.....	371	(D)	44.8	26.1	29.1
Other transportation equipment.....	373-75,379	(D)	53.4	20.0	26.6
Aircraft and missiles.....	372,376	23,506	36.9	23.3	39.8
Professional and scientific instruments....	38	5,456	50.5	16.7	32.8
Scientific and mechanical measuring instruments.....	381-82	(D)	54.7	12.4	32.8
Optical, surgical, photographic, and other instruments.....	383-87	(D)	48.6	18.6	32.8
Other manufacturing industries.....	27,31,39	(D)	58.8	10.7	30.5
Nonmanufacturing industries.....	08,10-12,14-17 40-67,72-73, 806-07,891	8,743	42.1	10.4	47.5

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of 50 percent or more.

SOURCE: National Science Foundation, SRS

95 Table B-44. Full-time-equivalent number of R&D scientists and engineers by industry and size of company: 1957-58, 1963-64, 1967-68, and 1974-80

(In thousands)

Industry and size of company	SIC code	1957	1958	1963	1964	1967	1968	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Total (January).....		229.4	234.0	327.3	340.2	367.2	374.7	360.0	363.3	364.4	382.0	404.4	423.9	450.4	487.0	509.0	541.9	586.5	626.2	676.5	703.0	725.0
Total (Annual average).....		232.1	256.1	333.0	341.9	372.0	381.9	361.7	363.9	373.6	393.4	414.2	437.3	469.2	498.0	525.9	564.2	606.4	651.4	690.2	714.0	734.0
Distribution by industry																						
Food, kindred, and tobacco products(1).....	20,21	3.0	4.0	5.1	5.7	4.1	4.3	4.4	4.0	6.9	6.9	6.9	7.4	7.2	7.4	7.4	7.7	7.4	(8)	(8)	(8)	(5)
Textiles and apparel.....	22,23	0.7	0.0	1.0	1.2	1.9	2.5	1.0	1.0	1.0	1.7	1.0	1.0	(2)	2.0	1.9	2.2	2.3	2.0	2.4	2.5	2.4
Lumber, wood products, and furniture.....	24,25	0.0	0.0	0.5	0.5	0.5	0.5	2.1	2.3	2.1	2.1	2.0	1.0	1.7	1.6	(2)	1.0	(2)	(5)	(5)	(5)	1.5
Paper and allied products.....	26	1.5	1.7	2.5	3.0	4.7	4.0	4.9	5.0	5.2	4.3	4.5	7.1	7.4	0.0	0.4	7.4	4.6	4.4	6.4	5.8	6.3
Chemicals and allied products.....	28	29.4	31.0	38.3	35.0	34.9	38.9	41.0	45.2	44.4	46.4	40.3	50.0	51.4	54.7	41.4	47.3	49.0	71.1	75.0	73.0	74.9
Industrial chemicals.....	281-82,286	10.0	10.0	22.9	22.2	21.7	22.3	19.1	21.1	20.1	20.4	21.3	21.4	20.9	21.4	25.9	26.4	25.4	23.5	24.9	24.4	(8)
Drugs and medicines.....	283	4.7	5.1	4.9	4.9	0.7	9.0	14.0	15.4	14.4	17.0	19.5	20.0	21.6	23.3	25.4	28.2	(2)	30.8	31.0	29.2	31.2
Other chemicals.....	284-85,287-89	4.7	7.1	0.5	4.7	4.5	6.0	0.7	0.5	7.0	0.0	7.5	7.0	0.9	9.0	10.1	12.1	13.4	14.7	19.1	19.4	20.5
Petroleum refining and extraction.....	13,29	4.9	7.4	0.9	0.1	0.7	9.2	0.2	0.4	0.4	0.9	9.9	10.1	10.0	13.0	15.4	14.7	13.3	13.5	10.4	0.6	9.5
Rubber products.....	30	4.7	4.7	5.0	4.0	5.0	6.1	7.7	0.4	0.6	9.1	7.9	0.1	(1)	10.3	0.1	(2)	(2)	(5)	(8)	(5)	(8)
Stone, clay, and glass products.....	32	(3)	(3)	3.0	3.3	3.3	4.1	4.5	4.5	4.4	4.5	5.1	5.2	5.4	5.4	5.1	5.5	5.4	4.4	7.5	0.4	0.6
Primary metals.....	33	5.1	5.2	5.2	5.1	5.9	5.9	6.4	4.3	0.1	0.4	0.1	7.9	0.1	7.9	0.4	0.3	0.3	9.1	12.1	13.2	11.2
Ferrous metals and products.....	331-32,3390-99	2.9	3.0	2.9	2.0	3.3	3.1	3.3	3.3	3.9	3.9	4.2	4.3	4.7	4.0	5.2	5.2	5.1	4.2	0.9	10.0	7.7
Nonferrous metals and products.....	333-36	2.2	2.2	2.3	2.3	2.5	2.7	3.1	3.0	4.2	4.5	3.9	3.4	3.4	3.1	3.2	3.0	3.1	2.9	3.2	3.2	3.4
Fabricated metal products.....	34	0.4	0.3	4.0	7.0	4.3	5.6	7.3	7.4	4.0	7.1	7.0	4.0	7.0	7.0	0.2	(2)	16.4	(5)	(5)	(5)	(8)
Machinery.....	35	24.9	27.4	31.4	27.3	33.4	37.4	51.0	52.0	53.7	53.3	57.0	60.2	62.1	69.2	74.0	80.7	83.0	91.2	102.0	103.0	103.9
Office, computing, and accounting machines.....	357	(4)	(4)	(4)	(4)	(4)	(4)	34.5	36.1	38.1	37.7	38.9	40.9	41.0	43.7	48.1	52.4	56.5	41.0	71.9	73.0	74.0
Other machinery, except electrical.....	351-56,358-59	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	10.9	19.3	20.3	25.5	27.9	28.1	27.3	29.4	30.1	29.2	29.9
Electrical equipment.....	36	42.9	47.9	85.0	89.5	90.4	90.4	82.4	82.4	80.3	84.1	84.4	85.0	94.5	106.9	109.0	111.3	110.3	110.6	124.0	135.7	139.7
Radio and TV receiving equipment.....	365	(4)	(4)	(4)	(4)	0.9	1.0	1.3	1.0	1.1	0.9	1.5	2.1	4.0	7.9	7.0	(2)	(2)	(5)	1.0	1.4	1.3
Communication equipment.....	366	19.2	22.3	55.1	60.4	64.7	67.4	42.0	40.2	37.4	38.0	39.0	40.4	42.4	44.2	45.9	48.9	59.9	62.9	65.0	74.4	74.3
Electronic components.....	367	23.7	25.4	30.7	29.1	31.0	30.0	9.4	10.4	10.2	13.0	14.2	14.0	10.1	22.0	24.4	25.4	(2)	29.4	(5)	41.0	44.0
Other electrical equipment.....	361-64,369	23.7	25.4	30.7	29.1	31.0	30.0	29.7	30.0	31.4	32.2	29.7	20.5	30.0	32.0	31.7	(2)	22.0	22.4	21.3	10.7	(5)
Transportation equipment.....	37	72.3	73.6	111.0	124.4	125.4	125.4	99.0	95.4	94	102.1	115.0	123.7	125.6	131.7	122.3	131.0	(2)	151.4	164.4	176.0	180.0
Motor vehicles and motor vehicles equipment.....	371	13.4	15.0	21.1	23.3	25.2	24.3	1.0	1.9	1.7	1.9	1.9	2.0	1.5	1.4	1.2	2.2	(2)	(5)	(5)	(8)	(8)
Other transportation equipment.....	373-75,379	58.7	58.4	90.7	101.1	100.4	101.1	70.4	47.5	44.9	72.0	62.0	86.5	85.9	95.2	91.1	100.4	107.1	121.3	132.0	121.0	129.1
Aircraft and missiles.....	372,374	10.2	11.0	9.4	10.0	13.0	14.1	17.5	17.9	10.0	20.5	23.3	27.0	32.0	34.7	42.7	(2)	(2)	(8)	(5)	(8)	(8)
Professional and scientific instruments.....	38	10.2	11.0	9.4	10.0	13.0	14.1	17.5	17.9	10.0	20.5	23.3	27.0	32.0	34.7	42.7	(2)	(2)	(8)	(5)	(8)	(8)
Scientific and mechanical measuring instruments....	381-82	5.0	4.5	3.9	3.0	3.4	3.0	5.4	5.9	4.7	7.2	9.0	11.7	(2)	10.4	(2)	(2)	(2)	(5)	(8)	(8)	(8)
Optical, surgical, photographic, and other instruments.....	383-87	4.4	4.5	5.5	7.0	9.4	10.3	11.9	12.0	12.1	13.3	14.3	15.3	16.3	16.0	16.1	(2)	(2)	20.2	24.9	27.4	(5)
Other manufacturing industries.....	27,31,39	17.0	19.2	0.2	9.0	14.1	15.1	14.4	14.9	14.6	15.3	15.0	17.1	19.0	22.2	27.1	31.1	49.3	65.9	73.9	86.9	
Nonmanufacturing industries.....	40,46-42,44-47, 49-67,72-73, 800-87,891																					
Distribution by size of company (based on number of employees)																						
Less than 500.....		44.0	48.0	34.1	32.5	27.4	27.2	20.0	30.1	30.2	31.1	29.5	30.5	34.4	30.0	40.7	53.5	83.0	01.0	(8)	110.0	120.4
500 to 999.....																			14.7	(8)	21.9	20.0
1,000 to 4,999.....		22.4	24.0	35.0	34.5	30.5	29.9	20.0	29.9	29.3	20.9	27.5	30.9	34.0	30.9	42.0	48.4	52.0	41.9	47.2	74.3	83.3
5,000 to 9,999.....						24.0	24.6	26.4	26.1	28.4	28.7	30.7	29.6	47.2	34.4	29.9	30.0	29.0	39.4	40.3	42.2	
10,000 to 24,999.....		162.2	171.0	250.2	273.2			45.9	47.4	50.4	49.3	52.1	55.4	64.4	71.0	77.0	80.4	83.3	80.9	86.0	81.3	90.0
25,000 or more.....						205.3	295.0	230.9	220.5	220.2	244.9	264.4	274.2	287.4	311.0	312.7	326.1	336.2	348.7	366.9	375.4	369.9

(8) Data have been withheld due to imputation of 50 percent or more.

(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

(2) Not separately available but included in total. See general notes.

(3) Data included in the other manufacturing industries group.

(4) Data not tabulated at this level prior to the 1972 survey.

(5) Data not tabulated at this level prior to the 1977 survey.

(6) Included in the other electrical equipment group.

N/A Not available

SOURCE: National Science Foundation, DRS

Table B-45. Number of full-time equivalent R&D scientists and engineers
by industry and source of R&D funds: January 1988

Industry	SIC Code	Total	Federal	Company
Total.....	.....	725.8	199.3	(S)
Food, kindred, and tobacco products.....	20,21	(S)	(D)	(D)
Textiles and apparel.....	22,23	2.4	(D)	(D)
Lumber, wood products, and furniture.....	24,25	1.5	(D)	(D)
Paper and allied products.....	26	6.3	0.0	6.3
Chemicals and allied products.....	28	74.9	1.0	(S)
Industrial chemicals.....	281-82,286	(S)	0.9	(S)
Drugs and medicines.....	283	31.2	(D)	(D)
Other chemicals.....	284-85,287-89	20.5	(D)	(D)
Petroleum refining and extraction.....	13,29	9.5	0.1	9.3
Rubber products.....	30	(S)	(D)	(D)
Stone, clay, and glass products.....	32	8.6	(D)	(D)
Primary metals.....	33	11.2	(D)	(D)
Ferrous metals and products.....	331-32,3398-99	7.7	(D)	(D)
Nonferrous metals and products.....	333-36	3.4	(S)	(S)
Fabricated metal products.....	34	(S)	1.3	(S)
Machinery.....	35	103.9	6.3	97.6
Office, computing, and accounting machines.....	357	74.0	(D)	(D)
Other machinery, except electrical.....	351-56,358-59	29.9	(D)	(D)
Electrical equipment.....	36	139.7	41.9	(S)
Radio and TV receiving equipment.....	365	1.3	0.0	1.3
Communication equipment.....	366	74.3	29.5	44.8
Electronic components.....	367	44.0	(D)	(D)
Other electrical equipment.....	361-64,369	(S)	(D)	(D)
Transportation equipment.....	37	180.8	102.7	78.1
Motor vehicles and motor vehicles equipment.....	371	(D)	(D)	36.1
Other transportation equipment.....	373-75,379	(D)	(D)	3.6
Aircraft and missiles.....	372,376	129.1	90.7	38.4
Professional and scientific instruments....	38	(S)	(S)	(S)
Scientific and mechanical measuring instruments.....	381-82	(S)	(D)	(D)
Optical, surgical, photographic, and other instruments.....	383-87	(S)	(D)	(D)
Other manufacturing industries.....	27,31,39	(S)	(D)	(D)
Nonmanufacturing industries.....	08,10-12,14-17 40-67,72-73, 806-07,891	98.0	(S)	(S)

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of 50 percent or more.

SOURCE: National Science Foundation, SRS

Table B-66. Cost per R&D scientist or engineer by industry and size of company: 1957-58, 1963, 1967, 1972, and 1973-87

Industry and size of company	BIC code	1957	1958	1963	1967	1972	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Total.....		932,700	932,800	637,800	944,100	433,300	963,500	946,500	972,200	175,900	800,400	607,400	694,900	9183,900	9112,200	9116,800	9125,500	9131,400	9138,300	9156,700
Distribution by industry																				
Food, kindred, and tobacco products(1).....	28-21	17,200	16,800	75,200	29,500	39,500	43,200	48,900	51,400	60,100	64,000	72,500	80,900	(B)	(B)	(B)	(B)	(B)	(B)	148,400
Textiles and apparel.....	22-23	28,000	28,700	26,400	25,900	32,100	38,300	38,900	44,900	47,400	49,400	53,200	57,500	(B)	(B)	(B)	(B)	(B)	(B)	(1)
Lumber, wood products, and furniture.....	28-25	17,500	13,300	22,000	28,000	33,700	38,200	40,000	51,000	40,800	64,500	79,400	89,700	(B)	(5)	(5)	115,400	116,300	(5)	87,500
Paper and allied products.....	26	21,900	22,700	27,000	26,900	38,600	47,900	48,800	54,400	52,000	34,900	61,400	68,500	(B)	78,800	(B)	(B)	(B)	(B)	(B)
Chemicals and allied products.....	28	23,500	24,400	32,600	39,800	47,100	34,500	60,900	44,500	67,400	72,800	79,800	87,400	96,400	102,500	104,800	112,300	116,300	118,900	132,900
Industrial chemicals.....	281-42,286	27,000	28,400	54,000	43,900	36,000	63,500	67,500	74,700	79,800	88,200	92,000	103,600	110,800	122,100	123,100	132,400	140,800	144,100	163,000
Drugs and medicines.....	283	21,200	23,500	38,400	37,100	44,500	54,300	48,900	63,400	59,900	64,800	71,400	79,200	(B)	(B)	103,100	(B)	(B)	119,900	(B)
Other chemicals.....	284-45,287-49	14,200	15,500	27,900	29,800	33,600	45,500	43,200	59,900	53,800	61,600	64,500	64,500	(B)	(B)	(B)	(B)	(B)	86,400	(B)
Petroleum refining and extraction.....	13-29	29,500	32,800	33,400	41,500	57,100	74,900	81,500	87,200	97,700	104,800	128,800	138,400	(B)	(B)	(B)	(B)	(B)	(B)	209,800
Rubber products.....	30	72,000	18,700	26,500	38,800	33,100	38,500	54,900	34,700	57,800	61,400	(B)	(B)	(B)	(B)	75,400	(B)	(B)	(B)	(B)
Stone, clay, and glass products.....	32	(3)	(3)	24,000	34,000	43,600	48,200	51,200	57,800	59,800	62,900	67,200	23,800	(B)	(B)	(B)	(B)	(B)	118,100	119,200
Primary metals.....	33	21,000	28,000	33,700	41,000	44,700	55,900	61,500	61,300	63,200	79,000	79,500	91,800	107,700	119,900	135,300	(B)	(B)	(B)	(B)
Ferrous metals and products.....	331-32,339-99	21,700	28,400	37,400	42,200	44,200	36,800	59,700	65,600	70,100	73,900	83,300	93,500	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Nonferrous metals and products.....	333-34	20,000	23,200	33,500	41,200	48,800	57,100	63,300	57,500	68,500	65,600	74,000	87,700	(B)	(B)	(B)	109,700	129,200	132,200	134,900
Fabricated metal products.....	34	16,200	18,900	22,200	27,800	37,600	42,500	45,600	51,500	36,900	53,700	62,300	70,500	70,600	(B)	(B)	111,400	112,900	(B)	86,800
Machinery.....	35	75,600	27,500	31,800	37,400	48,000	57,500	58,900	64,800	68,800	72,600	78,900	89,900	93,900	102,900	107,700	128,100	128,900	(B)	(B)
Office, computing, and accounting machines.....	357	(4)	(4)	(4)	(4)	48,500	59,400	(5)	63,900	69,500	72,300	77,700	92,700	(B)	(B)	(B)	(B)	(B)	(B)	(B)
Other machinery, except electrical.....	351-56,358-59	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(2)	23,300	31,400	80,700	(B)	(B)	(B)	(B)	(B)	102,700	100,200
Electrical equipment.....	36	39,700	38,200	33,800	39,500	35,400	60,700	62,700	68,800	69,900	76,400	87,200	91,100	95,300	101,500	115,700	121,400	125,800	121,800	122,900
Radio and TV receiving equipment.....	365	(6)	(6)	(6)	47,400	26,700	44,300	47,600	32,000	96,800	72,200	86,300	93,400	(B)	(B)	105,300	(B)	(B)	83,100	105,900
Communication equipment.....	366	36,000	34,400	31,700	34,200	57,800	59,000	61,500	64,100	78,800	75,500	87,800	92,900	105,300	121,500	131,100	134,100	137,700	128,500	128,100
Electronic components.....	367	42,800	41,900	35,400	45,600	33,700	48,400	52,700	59,600	34,400	68,400	72,800	75,800	64,700	69,400	(B)	106,300	114,100	(B)	(B)
Other electrical equipment.....	361-64,369	42,800	41,900	35,400	45,600	33,700	48,400	52,700	59,600	34,400	68,400	72,800	75,800	64,700	69,400	(B)	106,300	114,100	(B)	(B)
Transportation equipment.....	37	49,400	53,800	49,400	54,700	68,100	81,500	91,100	103,700	111,700	113,600	122,900	135,200	147,600	162,600	180,700	211,400	223,100	(B)	(B)
Motor vehicles and motor vehicles equipment.....	371	49,400	53,800	49,400	54,700	68,100	81,500	91,100	103,700	111,700	113,600	122,900	135,200	147,600	162,600	180,700	211,400	223,100	(B)	(B)
Other transportation equipment.....	372-75,379	43,900	41,900	49,800	36,500	32,900	45,800	50,000	32,200	63,200	67,200	90,900	111,700	(B)	(B)	114,200	(B)	(B)	(5)	(5)
Aircraft and missiles.....	372,376	43,900	41,900	49,800	36,500	32,900	45,800	50,000	32,200	63,200	67,200	90,900	111,700	(B)	(B)	114,200	(B)	(B)	(5)	(5)
Professional and scientific instruments.....	38	23,500	25,400	29,900	40,000	53,200	60,700	63,900	64,700	71,700	79,400	83,800	89,700	93,600	(B)	(B)	114,900	172,000	(B)	116,400
Scientific and mechanical measuring instruments.....	381-82	72,000	25,100	18,400	28,100	32,600	38,400	42,200	46,800	55,800	68,700	(B)	(B)	(B)	(B)	83,200	(B)	(B)	(B)	(B)
Optical, surgical, photographic, and other instruments.....	383-87	24,700	29,100	37,500	44,500	62,800	71,500	75,500	77,900	81,100	89,700	98,400	103,800	(B)	(B)	141,100	(B)	(B)	(B)	(B)
Other manufacturing industries.....	27,31,39	(2)	(2)	23,700	39,100	48,800	47,800	51,900	51,700	53,600	57,200	61,900	77,400	(B)	(B)	98,500	(B)	(B)	(B)	(B)
Nonmanufacturing industries.....	00,10-12,14-17, 60-67,72-73, 804-87,891	(2)	(2)	31,000	38,500	43,600	52,400	49,700	34,500	63,200	76,100	83,500	86,400	77,200	86,400	85,100	89,000	101,800	97,900	94,900
Distribution by size of company																				
Less than 500.....		11,800	12,000	18,600	75,200	32,400	36,400	40,500	45,200	48,700	47,900	53,500	36,500	58,600	67,600	69,600	62,000	(B)	77,400	76,400
500 to 999.....		27,200	75,100	29,400	53,700	40,600	46,700	46,800	51,600	34,100	44,100	70,200	48,600	77,800	85,500	82,700	97,800	97,800	105,200	102,500
1,000 to 4,999.....		39,800	38,700	41,400	45,800	40,700	51,800	53,700	57,500	63,500	79,400	86,200	90,900	97,200	108,000	123,100	119,800	120,800	145,000	
5,000 to 9,999.....					45,800	63,600	72,700	76,400	82,700	80,000	88,800	96,200	105,800	117,200	129,300	135,100	165,800	136,600	154,500	168,400
10,000 to 24,999.....																				
25,000 or more.....																				

Notes: The number of full-time-equivalent R&D scientists and engineers used to estimate the cost per R&D scientist or engineer is the arithmetic mean of the numbers of R&D scientists and engineers reported for January to June consecutive years. This number is then divided into total, earlier-year, R&D expenditures, and the ratio is attributed to the earlier year.

(B) Data have been withheld to avoid disclosing operations of individual companies.

(5) Data have been withheld due to legislation of 50 percent or more.

(1) Until 1984, tobacco products, SIC 21, are included with "other manufacturing industries."

(2) Not separately available but included in total. See general notes.

(3) Included in the other manufacturing group.

(4) Data not included at this level prior to 1972.

(5) Data not included at this level prior to 1977.

(6) Included in the other electrical equipment group.

Table B-47. Cost per R&D scientist or engineer(1) by industry and size of company: 1987

Industry	SIC code	Companies with total employment of--						
		Total	Less than 500	500 to 999	1,000 to 4,999	5,000 to 9,999	10,000 to 24,999	25,000 or more
Total.....		\$134,700	\$76,400	\$94,500	\$102,500	\$124,300	\$145,000	\$160,600
Food, kindred, and tobacco products.....	20,21	148,400	188,000	(S)	148,100	271,000	99,200	(S)
Textiles and apparel.....	22,23	(D)	45,900	(D)	217,400	76,800	70,400	102,900
Lumber, wood products, and furniture.....	24,25	87,500	30,300	59,200	101,700	(D)	107,400	(D)
Paper and allied products.....	26	(D)	229,200	92,300	81,800	64,700	114,200	(D)
Chemicals and allied products.....	28	132,900	51,700	94,900	134,500	122,300	153,500	(S)
Industrial chemicals.....	281-82,286	163,000	90,000	87,200	177,500	106,900	286,000	(S)
Drugs and medicines.....	283	(D)	45,200	105,700	147,200	136,200	144,900	(D)
Other chemicals.....	284-85,287-89	(D)	50,900	95,000	101,700	0	129,500	(D)
Petroleum refining and extraction.....	13,29	209,800	37,200	(D)	84,300	258,500	(D)	229,600
Rubber products.....	30	(D)	59,200	81,400	56,300	(S)	129,500	(D)
Stone, clay, and glass products.....	32	119,200	105,800	(S)	67,300	(D)	135,900	(D)
Primary metals.....	33	(D)	47,100	127,900	93,000	165,900	121,400	(D)
Ferrous metals and products.....	331-32,3398-99	(D)	26,400	254,900	103,700	(D)	82,700	(D)
Nonferrous metals and products.....	333-36	136,900	107,100	73,100	89,000	(D)	159,800	(D)
Fabricated metal products.....	34	86,800	72,800	75,900	96,200	(D)	96,800	(D)
Machinery.....	35	(D)	63,000	138,100	103,800	91,300	(D)	160,700
Office, computing, and accounting machines.....	357	(D)	38,800	158,100	103,700	(D)	(D)	(D)
Other machinery, except electrical.....	351-56,358-59	100,200	81,600	119,300	104,100	(D)	141,300	(D)
Electrical equipment.....	36	122,900	82,900	91,700	95,100	(S)	148,100	131,400
Radio and TV receiving equipment.....	365	105,900	68,000	(D)	69,800	0	(D)	0
Communication equipment.....	366	128,100	72,100	75,400	101,500	85,100	178,100	131,400
Electronic components.....	367	(D)	100,300	(D)	94,700	(S)	(D)	(D)
Other electrical equipment.....	361-64,369	(D)	66,500	87,300	88,600	(S)	167,100	(D)
Transportation equipment.....	37	187,200	88,000	114,000	98,000	(S)	185,800	(D)
Motor vehicles and motor vehicles equipment.....	371	(D)	(D)	105,800	96,100	72,500	169,900	(D)
Other transportation equipment.....	373-75,379	(S)	(D)	110,400	145,900	(D)	101,200	0
Aircraft and missiles.....	372,376	188,000	(D)	(D)	94,700	(D)	259,300	186,800
Professional and scientific instruments.....	38	116,600	65,400	(S)	89,800	110,200	88,800	(S)
Scientific and mechanical measuring instruments..	381-82	(D)	57,500	(S)	91,000	116,700	(D)	(D)
Optical, surgical, photographic, and other instruments.....	383-87	(D)	77,200	(S)	88,900	109,500	(D)	(D)
Other manufacturing industries.....	27,31,39	(D)	30,300	24,800	65,600	(D)	83,400	0
Nonmanufacturing industries.....	08,10-12,14-17, 40-67,72-73, 806-07,891	94,600	84,800	104,000	98,900	139,800	96,800	(S)

(1) See note on table B-46.

(D) Data have been withheld to avoid disclosing operations of individual companies.

(S) Data have been withheld due to imputation of 50 percent or more.

SOURCE: National Science Foundation, SRS

Table B-48. Cost per R&D scientist or engineer(1) in companies ranked by size of R&D program: 1972 and 1974-87

Companies ranked by size of R&D program (based on total R&D funds)	1972	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
First 4.....	\$64,500	\$80,700	\$90,500	\$102,500	\$105,200	\$109,400	\$121,700	\$126,700	\$160,200	\$182,800	\$185,200	\$202,000	\$225,800	\$225,900	\$224,100
Next 4.....	76,300	80,500	84,000	87,600	94,600	103,800	105,700	119,200	138,900	127,600	154,000	167,000	176,200	171,400	208,500
Next 12.....	63,100	76,900	80,600	82,900	79,300	83,800	90,500	93,300	107,000	127,500	119,300	127,800	132,500	131,200	130,900
Next 20.....	57,500	62,200	66,400	68,200	75,900	80,800	87,600	97,400	101,700	104,200	117,800	121,000	144,000	125,600	141,400
Next 60.....	51,000	66,200	61,400	65,200	69,900	74,200	80,100	90,700	96,400	98,000	118,800	130,400	124,100	139,000	139,400
Next 100.....	41,600	49,900	52,400	53,400	57,200	58,700	63,400	71,400	87,900	99,200	96,300	108,900	122,800	146,700	132,800
Next 200.....	39,700	44,000	43,600	48,300	54,200	56,900	61,200	72,800	79,900	86,900	86,400	97,300	94,100	138,000	116,800
Average of above 400 R&D performing companies.....	57,200	66,900	70,400	74,300	78,100	82,200	88,500	96,600	114,400	118,500	125,400	139,000	144,400	160,400	154,100

(1) See note on table B-46.

SOURCE: National Science Foundation, SRS

Table B-49. Total domestic employment of R&D-performing companies by industry and size of company: 1986-87

Industry	SIC code	1986						1987							
		Companies with total employment of--						Companies with total employment of--							
		Total	Less than 500	500 to 999	1,000 to 4,999	5,000 to 9,999	10,000 to 24,999 or more	Total	Less than 500	500 to 999	1,000 to 4,999	5,000 to 9,999	10,000 to 24,999 or more		
Total.....	17,111	1,306	589	2,291	1,492	3,147	8,286	17,645	1,376	607	2,369	1,470	3,324	8,499	
Food, kindred, and tobacco products.....	20,21	1,295	3	31	126	107	227	801	1,298	3	29	131	112	229	794
Textiles and apparel.....	22,23	686	76	(5)	89	59	119	264	698	70	(5)	83	52	192	221
Lumber, wood products, and furniture.....	24,25	289	(0)	27	81	38	66	(0)	311	(0)	25	79	45	74	(0)
Paper and allied products.....	26	537	30	13	80	64	228	122	558	34	10	81	71	201	161
Chemicals and allied products.....	28	1,056	97	30	149	87	362	331	1,095	104	30	159	87	412	303
Industrial chemicals.....	281-82,286	440	6	7	37	51	117	222	447	6	6	51	50	114	220
Drugs and medicines.....	283	312	15	5	36	(0)	173	(0)	312	(0)	5	32	37	185	(0)
Other chemicals.....	284-85,287-89	304	76	18	76	(0)	72	(0)	336	(0)	19	76	0	113	(0)
Petroleum refining and extraction.....	13,29	491	10	3	32	35	49	362	454	8	4	28	33	69	312
Rubber products.....	30	489	(0)	28	178	68	93	(0)	536	(0)	32	199	66	119	(0)
Stone, clay, and glass products.....	32	393	15	(5)	62	58	97	137	358	15	23	65	30	119	106
Primary metals.....	33	541	25	20	109	85	118	184	527	25	20	112	86	119	165
Ferrous metals and products.....	331-32,3398-99	351	(0)	8	57	52	68	(0)	313	(0)	9	54	57	48	(0)
Nonferrous metals and products.....	333-36	190	(0)	12	52	33	50	(0)	214	(0)	11	58	29	71	(0)
Fabricated metal products.....	34	579	(0)	38	123	91	135	(0)	627	(0)	43	122	62	175	(0)
Machinery.....	35	1,447	225	72	309	143	182	516	1,419	226	77	301	172	147	496
Office, computing, and accounting machines.....	357	680	(0)	17	109	24	49	(0)	656	30	18	104	38	(0)	(0)
Other machinery, except electrical.....	351-56,358-59	767	(0)	55	200	119	133	(0)	763	196	59	197	134	(0)	(0)
Electrical equipment.....	36	2,092	201	63	240	100	391	1,097	2,119	214	66	256	107	396	1,080
Radio and TV receiving equipment.....	365	29	5	(0)	11	0	(0)	0	31	5	(0)	12	0	(0)	0
Communication equipment.....	366	1,017	38	(0)	58	36	(0)	764	1,029	41	(0)	56	37	(0)	736
Electronic components.....	367	465	79	24	69	23	96	174	473	85	23	83	30	78	174
Other electrical equipment.....	361-64,369	581	79	26	102	(5)	175	159	586	83	31	105	40	157	170
Transportation equipment.....	37	2,619	32	29	88	141	215	2,114	2,703	42	31	113	115	255	2,147
Motor vehicles and motor vehicles equipment.....	371	1,117	(0)	(0)	45	82	61	894	1,185	(0)	17	53	(0)	95	926
Other transportation equipment.....	373-75,379	108	14	5	19	23	47	0	118	(0)	8	29	(0)	53	0
Aircraft and missiles.....	372,376	1,394	(0)	(0)	24	36	107	1,220	1,400	(0)	6	31	(0)	107	1,221
Professional and scientific instruments.....	38	651	92	30	99	63	71	296	626	98	34	95	64	60	275
Scientific and mechanical measuring instruments..	381-82	239	53	13	49	27	(0)	(0)	229	56	14	46	27	(0)	(0)
Optical, surgical, photographic, and other instruments.....	383-87	412	39	17	50	37	(0)	(0)	397	42	20	49	37	(0)	(0)
Other manufacturing industries.....	27,31,39	335	(0)	32	107	26	120	(0)	356	(0)	31	104	42	126	(0)
Nonmanufacturing industries.....	08,10-12,14-17,40-67,72-73,806-07,891	3,611	229	73	419	327	676	1,887	3,960	261	73	441	325	630	2,230

(D) Data have been withheld to avoid disclosing operations of individual companies.
(S) Data have been withheld due to imputation of 50 percent or more.

SOURCE: National Science Foundation, SRS

Table B-50. R&D scientists and engineers per 1,000 employees by industry and size of company: 1958, 1963, 1967, 1972, and 1974-87

Industry and size of company	SIC code	1958	1963	1967	1972	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Distribution by industry																			
Total.....		21	28	27	24	25	26	27	27	27	27	27	29	33	34	40	43	45	
Food, kindred, and tobacco products(1).....	20,21	6	7	7	7	7	7	7	7	7	6	5	6	6	6	7	8	7	
Textiles and apparel.....	22,23	1	3	3	3	3	3	3	3	3	3	3	3	4	4	5	5	4	
Leather, wood products, and furniture.....	24,25	5	4	4	6	7	7	7	7	7	6	6	(8)	(5)	(5)	6	6	5	
Paper and allied products.....	26	6	6	6	8	8	10	12	12	14	14	14	16	14	12	13	13	11	
Chemicals and allied products.....	28	39	40	36	39	40	41	40	42	43	42	42	44	51	54	57	57	70	
Industrial chemicals.....	281-82,286	42	40	33	34	37	38	36	38	38	36	36	37	44	45	41	39	56	
Drugs and medicines.....	283	46	47	51	60	57	59	64	62	65	62	60	66	74	(5)	89	81	98	
Other chemicals.....	284-85,287-89	30	38	33	31	30	29	28	29	27	27	30	33	37	39	51	62	43	
Petroleum refining and extraction.....	13,29	15	17	18	16	18	19	17	17	19	18	17	20	22	22	22	21	19	
Rubber products.....	30	19	20	17	16	17	18	18	19	18	(5)	(8)	25	(5)	(5)	27	26	25	
Stones, clay, and glass products.....	32	(2)	12	14	18	11	11	11	12	13	13	13	15	16	17	20	20	20	
Primary metals.....	33	5	5	5	5	5	7	8	8	8	7	7	8	10	11	12	15	23	
Ferrous metals and products.....	331-32,3390-99	4	4	4	4	4	5	5	5	6	6	6	6	8	11	11	15	27	
Nonferrous metals and products.....	333-34	6	8	8	7	7	11	15	13	12	12	12	13	13	13	16	16	17	
Fabricated metal products.....	34	16	15	14	10	11	12	12	12	12	12	14	15	(5)	(5)	(5)	(5)	(5)	
Machinery.....	35	22	28	28	31	34	36	38	38	39	38	36	35	48	57	56	63	71	
Office, computing, and accounting machines.....	357	(3)	(3)	(3)	66	69	76	79	78	79	75	72	71	80	88	90	99	107	
Other machinery, except electrical.....	351-56,358-39	(4)	(4)	(4)	(4)	(4)	(4)	(4)	18	19	19	18	19	26	30	32	35	39	
Electrical equipment.....	36	43	55	43	37	37	40	42	42	41	43	44	48	55	51	49	53	62	
Radio and TV receiving equipment.....	365	(5)	(5)	18	26	18	16	15	17	22	29	35	51	(5)	(5)	(5)	23	35	
Communication equipment.....	366				42	43	44	45	46	48	53	55	56	74	61	56	62	69	
Electronic components.....	367				39	40	49	55	54	51	52	55	66	66	(5)	(5)	81	82	
Other electrical equipment.....	361-64,369	37	41	35	31	32	36	38	35	32	32	32	34	(5)	(5)	30	30	34	
Transportation equipment.....	37															(5)	71	65	
Motor vehicles and motor vehicles equipment.....	371				23	24	25	25	24	26	26	30	30	31	30	27	28	38	
Other transportation equipment.....	373-75,379	16	19	20															
Aircraft and missiles.....	372,376	72	99	89	76	72	72	78	85	96	93	92	98	94	96	121	126	91	
Professional and scientific instruments.....	38	44	36	32	33	35	38	41	41	42	41	39	46	(5)	(5)	(5)	(5)	(5)	
Scientific and mechanical measuring instruments....	381-82	57	38	26	31	35	41	45	45	50	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(8)	
Optical, surgical, photographic, and other instruments.....	383-87	33	35	35	34	35	37	38	41	44	45	48	47	(5)	(5)	(5)	70	63	
Other manufacturing industries.....	27,31,39		9	6	6	6	7	8	7	9	7	7	7	9	(5)	(5)	(5)	(5)	
Distribution by size of company (based on number of employees)																			
less than 500.....		18	27	28	28	29	26	25	24	25	24	25	28	30	34	42	50	59	
500 to 999.....																21	21	23	
1,000 to 4,999.....		12	19	16	19	17	17	17	17	18	18	19	21	22	25	24	26	32	
5,000 to 9,999.....				15	19	18	17	19	20	17	19	19	18	23	22	19	19	28	
10,000 to 24,999.....		25	31		16	16	17	18	19	20	19	20	23	26	26	29	30	33	
25,000 or more.....				31		31	33	35	34	35	34	34	36	43	42	47	49	56	

Note: The number of R&D scientists and engineers for 1987 is derived by dividing the arithmetic mean of scientists and engineers employed in January 1987 and January 1988 by the number of employees in all activities in March 1987. Similar procedures were used in earlier years except 1967-69 in which data were derived by dividing worker-years of R&D scientists and engineers for the year by March employment figures.

Nonmanufacturing industries are included in the calculations for 1958-83.

(8) Data have been withheld due to imputation of 50 percent or more.

(1) Until 1984, tobacco products, SIC 21, was included with "other manufacturing industries."

(2) Not separately available but included in total. See general notes.

(3) Data not tabulated at this level prior to the 1972 survey.

(4) Data not tabulated at this level prior to the 1977 survey.

(5) Included in the other electrical equipment group for 1958-63.

SOURCE: National Science Foundation, DRS

Table B-51. Total and companies' own R&D funds per employee by size of company: 1963, 1967, 1972, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987

Size of company (based on number of employees)	1963	1967	1972	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	Total R&D funds per employee																
Total.....	\$1,110	\$1,180	\$1,386	\$1,624	\$1,728	\$1,912	\$2,077	\$2,240	\$2,453	\$2,576	\$3,010	\$3,719	\$4,163	\$4,579	\$5,148	\$5,254	\$5,458
Less than 500.....	520	660	892	1,010	1,043	1,139	1,051	1,123	1,254	1,418	1,634	1,732	2,186	2,767	3,028	6,232	6,427
500 to 999.....																	
1,000 to 4,999.....	580	570	757	791	786	852	963	1,066	1,321	1,326	1,596	1,790	2,042	2,480	2,725	3,249	3,410
5,000 to 9,999.....		560	736	879	930	1,138	1,261	1,143	1,102	1,332	1,668	1,883	2,194	2,505	2,851	3,198	3,488
10,000 to 24,999.....	1,310		781	837	920	1,041	1,215	1,407	1,549	1,748	2,045	2,469	2,966	3,385	3,500	3,227	3,737
		1,470															
25,000 or more.....			1,962	2,421	2,644	2,829	2,994	3,045	3,614	3,594	4,193	5,502	5,785	6,184	7,071	6,910	7,042
Companies' own R&D funds per employee																	
Total.....	\$470	\$580	\$818	\$1,040	\$1,112	\$1,233	\$1,347	\$1,487	\$1,650	\$1,764	\$2,059	\$2,534	\$2,814	\$3,095	\$3,383	\$3,607	\$3,678
Less than 500.....	360	420	579	657	810	893	879	933	956	1,176	1,333	1,381	1,749	2,212	2,407	5,316	5,413
500 to 999.....																	
1,000 to 4,999.....	340	370	525	572	642	699	790	841	910	1,108	1,311	1,503	1,687	2,096	2,316	2,845	2,965
5,000 to 9,999.....		420	609	729	749	921	1,004	989	987	1,048	1,323	1,551	1,613	2,199	2,409	2,683	2,987
10,000 to 24,999.....	520		557	688	791	842	927	1,077	1,237	1,414	1,675	2,025	2,351	2,689	2,769	2,688	3,029
		660															
25,000 or more.....			1,059	1,432	1,519	1,651	1,781	1,873	2,271	2,273	2,641	3,436	3,637	3,792	4,208	4,102	4,020

Note: Averages were derived by dividing total and company R&D funds for a calendar year by employment data for March of that year.

SOURCE: National Science Foundation, SRS

Table B-52. Percent of employment of R&D-performing companies ranked by size of total R&D funds: 1984-87

Companies	1984	1985	1986	1987
First 4 (1-4).....	8	8	7	7
Next 4 (5-8).....	3	4	4	4
Next 12 (9-20).....	6	7	5	5
Next 20 (21-40).....	9	7	6	6
Next 60 (41-100).....	10	11	9	8
Next 100 (101-200)...	13	12	7	7
Next 200 (201-400)...	15	15	10	10

SOURCE: National Science Foundation, SRS

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NATIONAL SCIENCE FOUNDATION
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OFFICE OF THE
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Dear Respondent:

The National Science Foundation requests your company's participation in its 1987 Survey of Industrial Research and Development by completing the enclosed questionnaire and returning it to the U.S. Bureau of the Census.

This annual survey is the only source of detailed information on U.S. industrial firms' performance of research and development, which accounts for approximately 70 percent of total U.S. R&D expenditures. It is important, therefore, that data from your company are included so that the survey results will be accurate and complete. If your records do not contain the information requested for one or more of the data elements, it is important that you provide estimates. Your estimates are adequate substitutes for actual data as long as they are consistent from year to year and are based on reasonable assumptions. If you have not done so already, you may wish to ask your company's chief official responsible for research and development to assist you.

Your company's responses are kept confidential--the Foundation receives the data from the Census Bureau only after they have been aggregated by individual industries. Inquiries regarding the conduct of the survey should be directed to the U.S. Department of Commerce, Bureau of the Census, Industry Division, Washington, D.C. 20233.

We appreciate both your past and continuing participation in this survey. If you would like to receive the results of this survey or if you have a suggestion for improving any aspect of the survey, please contact Mr. William L. Stewart, Division Director, Division of Science Resources Studies, Room L-602, National Science Foundation, Washington, D.C. 20550.

Sincerely,



Erich Bloch
Director



UNITED STATES DEPARTMENT OF COMMERCE
Bureau of the Census

Washington, D.C. 20233

OFFICE OF THE DIRECTOR

FROM THE DIRECTOR
BUREAU OF THE CENSUS

The Bureau of the Census conducts the "Survey of Industrial Research and Development" under sponsorship of the National Science Foundation. These measures of research and development expenditures by industry are important in analyzing and forecasting long-term economic growth, investigating productivity determinants, formulating tax policy recommendations, and comparing individual research performance against industry averages. Once every 5 years a new sample of firms is selected to rotate respondent reporting burden and to ensure an accurate representation of all the firms.

We have selected your firm for our 1987 survey panel. We have enclosed copies of Form RD-1A, "Survey of Industrial Research and Development During 1987," and a letter from the National Science Foundation that emphasizes the survey's importance. The 1987 report on Form RD-1A should cover your entire domestic company.

This report is authorized by law (Title 13, United States Code). Item 2 and Columns 2 and 4 of Item 4A are part of the basic statistical program of the Bureau of the Census for manufacturing companies, and reporting of these items is mandatory. Response to the remainder of the inquiries is voluntary; however, your cooperation is needed to make the results of the survey comprehensive and accurate. By Section 9 of the same law (Title 13), your report to the Census Bureau is confidential. It will be seen only by sworn Census Bureau employees and used only for statistical purposes. The law also provides that copies retained in your files are immune from legal process.

We thank you for your cooperation in this survey. Requests for copies of the resulting publication or any questions concerning the survey should be directed to Patricia Garner of our Industry Division on (301) 763-5598.

Sincerely,

JOHN G. KEANE

Enclosures

INSTRUCTIONS FOR SURVEY OF INDUSTRIAL RESEARCH AND DEVELOPMENT DURING 1987

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GENERAL

Estimates Are Acceptable — Reporting on this form may require using informed estimates in answering some of the questions. These estimates are satisfactory if they are sufficient to develop both meaningful totals and, especially, measures of change from year to year. Direct any questions regarding this form to the Bureau of the Census, ATTN: Industry Division, Washington, D.C. 20233, or call (301) 763-5598.

Additional Forms — Photocopies of this form are acceptable. If you require additional copies of the form, write to the Bureau of the Census, 1201 East Tenth Street, Jeffersonville, Indiana 47132.

Companies Reporting in Survey for the First Time — Companies which did not report in the 1986 survey are asked to provide figures for both 1986 and 1987. If the company had no expenditures for research and development, complete only Item 1. Enter "No R&D" in the space for remarks on page 3 of the form, sign and return the form.

Figures for Earlier Years are Preposted on the Form — If your company reported for 1986, entries from that form have been copied on the present form. **Please describe in the "Remarks" section (page 3 of the form) the reasons for any substantial increases or decreases in the 1987 figures entered on this form when compared to corresponding 1986 figures.** Examples of such reasons are new government contracts, acquisitions and disposals, revised accounting method, etc. If you acquired or disposed of a unit performing an important amount of research and development during the 2-year period, please identify the unit in remarks, and give the total amount of research and development accounted for by such unit.

Revision of Earlier Year Figures — The 1986 figures should be revised if necessary to assure comparability with 1987 data. Please explain in remarks any significant change made in the 1986 figures. If no entries have been entered in the 1986 column, please fill in the figures for both years.

Certain items on this 1987 form are asked only every other year, and consequently no prior-year figures appear in the 1986 column. The figures your company reported in 1985 for these items are preposted, however, solely to assist you in reporting for 1987, and you are not required to make revisions in the 1985 data.

Report for Your Entire Company — Research and development (R&D) activities for your entire domestic company should be reported, including all subsidiaries, divisions, etc.

Period Covered by Report — The figures reported should cover the calendar year if possible. Fiscal year data, however, are acceptable for all items except employment. Please report employment figures (Item 1B and Item 3) for the specific period identified in each of the items mentioned.

Geographic Area Covered — The data relate to business firms which operate one or more establishments in one or more of the 50 States or the District of Columbia.

▶ Section I — GENERAL COMPANY DATA

▶ Item 1 — Sales and Employment for Company

Item 1A — Net Sales — Report the net sales and receipts of this company and its subsidiaries to customers outside the company, including sales of products and services to other companies, individuals, U.S. Government agencies, foreign customers; etc. Include transfers to foreign subsidiaries. Exclude domestic intra-company transfers and sales by foreign subsidiaries. The reported figures should represent value f.o.b. plant after discounts and allowances and should exclude freight charges and excise taxes.

Item 1B — Employment — Report the number of persons employed at the company in all activities in the 50 States or the District of Columbia during the pay periods which include March 12 of 1986 and 1987. This figure would be the same as that shown by the company in Item 14 of Treasury Form 941, if the company filed one Form 941 for the entire company.

▶ Section II — RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY IN THE UNITED STATES

▶ Item 2 — Research and Development Expenditures

Definition of Research and Development — Research and development includes basic and applied research in the sciences and in engineering, and design and development of prototype products and processes. For the purposes of this questionnaire, research and development includes activities carried on by persons trained, either formally or by experience, in the physical sciences including related engineering, and the biological sciences including medicine but excluding psychology, if the purpose of such activity is to do one or more of the following things:

1. Pursue a planned search for new knowledge, whether or not the search has reference to a specific application.
2. Apply existing knowledge to problems involved in the creation of a new product or process, including work required to evaluate possible uses.
3. Apply existing knowledge to problems involved in the improvement of a present product or process.

Research and development includes the activities described above whether assigned to separate R&D organizational units of the company or carried on by company laboratories and technical groups not part of an R&D organization. Reporting the R&D activities of such latter groups may require the use of estimates for some of the questions.

Activities to be Excluded from Research and Development — Research and development for purposes of this survey excludes capital expenditures, routine product testing, research in the social sciences or psychology, or other nontechnological activities or technical services. Please exclude geological and geophysical exploration activities; include, however, the research and development conducted in support of such activities, such as the development or improvement of techniques and processes.

ore specifically, exclude from research and development such nontechnological activities as market research, including statistical surveys, market development, economic research, and legal work in connection with patent applications and litigation and the sale or licensing of patents.

so exclude from research and development such technical services as: quality and quantity control tests and analyses; trouble-shooting in connection with breakdowns in full-scale production, including related analytical work; work required for minor adaptations of a specific product to meet the requirements of a specific customer, including installation and servicing in a customer's plant; engineering and other technical services furnished in accordance with agreements to licensees outside the company; aid furnished by the R&D organization to manufacturing divisions to enable them to operate in accordance with previously determined formulas, standard practice instructions, or finished product specifications; technical plant sanitation control; aid furnished to develop advertising programs and to promote or demonstrate new products or processes, including the cost of material furnished for trial or demonstration; assistance in preparation of speeches and publications for persons not engaged in research and development; and experimental work performed at the request of the patent division to provide information needed during the prosecution of a patent application.

Item 3 — Research and Development Scientists and Engineers

Scientists and engineers are defined for this survey as all persons engaged in scientific or engineering work at a level which requires knowledge of physical or life sciences or engineering mathematics that is equivalent at least to that required through completion of a 4-year college course with a major in these fields, regardless of whether they actually hold a college degree in the field.

The figure on R&D scientists and engineers will be obtained primarily from two sources:

Records on the number of scientists and engineers assigned to research and development. This source is satisfactory when the scientists and engineers are assigned to research and development on a full-time basis (i.e., no more than 5 percent of their time is spent on non-research and development). Thus, for company laboratories performing only research and development, report the number of scientists and engineers on the rolls in January. For other situations, see source 2.

Figures on the proportion of total work time of scientists and engineers that is devoted to research and development. For example, if the engineering department of a manufacturing plant had 60 scientists and engineers in January 1988 and one-fourth of the scientists' and engineers' time during that month was charged to R&D projects, the figure for the number of R&D scientists and engineers would be 15.

Separate figures are requested on the number of scientists and engineers working on Federal R&D projects, and company and other R&D projects. If R&D work for the Government and for the company is performed by the same group of scientists and engineers, distribute the total number of such scientists and engineers according to the program, Federal or company, for which the R&D work was performed.

Item 4 — Costs INCURRED FOR RESEARCH AND DEVELOPMENT PERFORMED Within the Company by Major Type and Source of Funds

Include all costs incurred to support research and development including R&D depreciation and overhead but excluding R&D capital expenditures. If you perform research and development for others on contract, report the total charged for the work performed, including profit.

Include in R&D expenditures the full cost of all research and development performed. Do not net your R&D expenditures by the amount of royalties received from either non-company organizations or company units, or the credits received for R&D work charged or "sold" to other units of the reporting company or to outside organizations.

The relevant costs for research and development usually include but are not limited to the elements listed below:

1. Wages, salaries, and related costs; materials and supplies consumed (or purchased, if consumption figures are not available); costs of computer software used in R&D activities, utilities, such as telephone, telex, electricity, water, gas, and fuel; books and periodicals; travel costs and professional dues.

2. Property taxes and other taxes (except income taxes) incurred on account of the R&D organization or the facilities which the R&D organization uses; insurance expense; maintenance and repair, including the maintenance of buildings and grounds; depreciation on buildings, equipment, and vehicles; and rentals, if any facilities are leased.

3. Company overhead. Estimate a fair share of the cost of any functions which support R&D activities. The basis and method of estimating overhead costs will depend upon company practice. Be sure that the company figures include an allowance for overhead. Items normally covered in overhead include the following: personnel; accounting; procurement and inventory, including purchasing, storage, transportation, control of materials and supplies, etc.; other services, including legal and public relations; and salaries and related costs of research executives not on the payroll of the R&D organization.

Types of Costs to be Excluded from Research and Development Performed Within the Company

Exclude capital expenditures, royalties paid, patent expense, income taxes, and interest; the portion of company-held R&D contracts which were subcontracted to R&D organizations outside the reporting company; and income from the sale of products manufactured in the R&D organization if these were sold to bonafide customers. Also exclude the cost of research and development performed for the company by noncompany R&D organizations of any kind. (All work that was done for your laboratories and other technical units by noncompany organizations which are **not** R&D organizations—for example, model construction by a noncompany model shop—is to be included as a **purchase** of equipment, material, or supplies for the company research organization rather than as subcontracted research and development.) Exclude fellowships, grants, and gifts to promote research and development or the study of science and engineering.

Methods of Estimating Research and Development Expenditures by Type — (Basic, Applied, and Development) — If your company does not keep records that meet or can be allocated to these specific categories, estimate by:

1. Isolating the **projects** that clearly fall in the development category. If your company fabricates products, such development activity will include the design, construction, and testing of prototypes and models. Some defense contracts typically call for several test models. If your company's research and development frequently involves the development of a "process" as in chemicals and petroleum, such development activity would include operations beyond the bench scale, primarily the design and operations of pilot plants or semiworks.

2. Isolating the **organizational units** which have R&D activities that can be readily classified, based on the function assigned to the unit. If R&D work is done in production units as well as in various laboratories, it is generally of a development type.

3. Distributing the **balance** on the basis of a review of individual projects or on the basis of other summaries of the work. Please use the definitions for basic, applied, and development, as given below.

Types of Research

- ▶ **Item 4A — Basic Research** — Include the cost of research projects which represent original investigation for the advancement of scientific knowledge and which do not have specific immediate commercial objectives, although they may be in the fields of present or potential interest to the reporting company.
- ▶ **Item 4B1 — Applied Research** — Include the cost of research projects which represent investigation directed to discovery of new scientific knowledge and which have specific commercial objectives with respect to either products or processes. Note that the chief difference between this definition of applied research and the definition of basic research is in terms of the objectives of the reporting company.
- ▶ **Item 4B2 — Development** — Include the cost of projects which represent technical activity concerned with nonroutine problems encountered in translating research findings or other general scientific knowledge into products or processes. Exclude routine technical services to customers or other items excluded from the definition of total research and development as explained in item 2 above.

Types of Activity Included in Development — Include the design and operation of pilot plants or semiworks plants as long as the principal purposes are to obtain experience and to compile engineering and other data to be used in such tasks as evaluating hypotheses, writing product formulas, establishing finished product specifications, designing special equipment and structures required by a process, and preparing operating instructions or manuals. Also include the engineering activity required to advance the design of a product or a process to the point where it meets specific functional and economic requirements and can be turned over to manufacturing units. Include the design, construction, and testing of preproduction prototypes and models and "engineering follow-through" in the early production phase; the development of designs

for special manufacturing equipment and tools; the preparation of reports, drawings, formulas, specifications, standard practice instructions or operating manuals, and other media used to transmit to operating units information obtained from the above activities.

Types of Activity Excluded from Development — Exclude activities such as toolmaking and tool tryout, production of detailed construction drawings and manufacturing blueprints, and preproduction planning.

It is often difficult to decide when development ends and production begins. In general, if the primary objective is to make further improvements on the product or process, then the work comes within the definition of research and development. If, on the other hand, the product or process is substantially "set," and the primary objective is to develop market, do preproduction planning, or get the production process going smoothly, then the work is no longer research and development.

Source of Funds — Federal and Company

- ▶ **Item 4, Column 2 — Federal** — Include the cost of work done on Federal R&D contracts or subcontracts and the R&D portions of procurement contracts and subcontracts during the year.

Do not include here, or elsewhere in the report, R&D contracts and the R&D portions of procurement contracts that you subcontracted to other R&D organizations. To do so would cause duplication in the statistical totals derived from these forms, which collect data on work actually performed by each company.

- ▶ **Item 4, Column 3 — Company and Other** — Include the cost of all company-sponsored research and development performed within the company as well as the research and development your company performed under contract from non-Federal sources. Exclude the research and development that was sponsored by your company but performed outside the company.
- ▶ **Item 4E — Company and Other Funds, except Federal, Budgeted for the year 1988** — Report the expected or estimated cost of company-sponsored other non-federally sponsored research and development that will be performed within the company within the 50 States and the District of Columbia.
- ▶ **Item 5 — Costs Incurred for Federal Research and Development by Principal Agency** — Distribute the cost of Federal research and development work (item 4C, column 2) by Federal agency — If exact figures are not available by agency, please estimate or apportion according to the number of scientists and engineers working on the Federal projects and/or the costs of Federal programs.
- ▶ **Item 6 — Costs Incurred for Research and Development Performed Within the Company by Major Type of Expense** — If most research and development is performed in units where summaries are regularly prepared by element of cost, base the breakdown of research and development costs upon the records of such units. If existing records do not yield figures for this item, the item may be estimated.

Item 6A — Wages and Salaries — Report the gross earnings paid in calendar year 1987 to employees engaged in research and development — (Follow the definition of salaries and wages that is used for calculating the withholding tax.) Include salaries of persons in the research establishment(s) if a corporation; exclude payments to proprietor or partners if an unincorporated concern. (Scientists and engineers are defined in item 3.)

Item 6B — Materials and Supplies — Report the covered cost for all purchased materials consumed, whether received from other companies, withdrawn from inventory, or received from other establishments of this company. Include all work that was done for your laboratories and other technical units by noncompany organizations which are not research and development organizations (for example, model construction by a noncompany model shop). Exclude purchases from other research and development organizations.

Item 6C — Other Costs — Include items related to your research and development activities and not included in items 6A and 6B. Include utilities, books, periodicals, property and other taxes, and company overhead.

Item 7 — Fields of Basic Research — Use the following definitions to help you divide your company's basic research into broad research fields.

Item 7A — Chemistry — Includes inorganic, organo-metallic, organic, and physical.

Item 7B — Engineering (including metallurgy) — Includes aeronautical, astronautical (including aerospace and space technology), chemical, nuclear, electrical, and mechanical engineering, etc.) and metallurgy and materials.

Item 7C — Geological Sciences — Includes geodesy, hydrology, geochemistry, seismology, soil sciences, etc.

Item 7D — Mathematics — Includes areas such as algebra; foundations and logic; geometry; numerical analysis, etc.

Item 7E — Computer Sciences — Includes activities directed toward enhancing our understanding of computer structures and computational processes to provide bases for the future capabilities for computational solutions of presently intractable problems.

Item 7F — Physics — Includes acoustics; atomic and molecular; condensed matter; elementary particle; nuclear structure; optics; plasma.

Item 7G — Astronomy — Includes laboratory astrophysics; optical astronomy; radio astronomy; theoretical astrophysics; Gamma-ray, neutrino astronomy.

Item 7H — Atmospheric Sciences — Includes astronomy; solar; weather modification; extraterrestrial atmospheres; meteorology.

Item 7I — Oceanography — Includes biological oceanography; chemical oceanography; physical oceanography; marine geophysics.

Item 7J — Biological Sciences — Includes all sciences (other than clinical medical sciences) which deal with life processes, including plant and animal sciences, biochemistry, cell biology, nutrition, microbiology, physiology, etc.

Item 7K — Clinical Medical Sciences — Includes all sciences concerned with the use of scientific knowledge for the identification, treatment, and cure of disease including internal medicine, neurology, preventive medicine and public health, pathology, pharmacology, psychiatry, dentistry, veterinary medicine, etc.

Item 7L — Other Sciences — To be used for multidisciplinary and interdisciplinary projects which cannot be classified within one of the above primary fields of science.

Item 7M — Total Basic Research Cost — This should be the same as Item 4A, column 4.

Item 8 — Applied Research and Development by Product Group — Enter both Federal and total cost of applied research and development by product group. Costs should be entered in the field which is the END PRODUCT for the firm performing the research and development. For example, research and development in very large scale integrated (VLSI) circuits would be classified by a semiconductor firm in product group 25, electronic components and accessories, if the chips are the final product sold by the firm. The same type of microelectronic research and development by a computer firm, however, would be classified in group 19, office, computing and accounting machines, if the chip were intended to be part of a computer which is the firm's end product.

Fields of applied research and development are listed below. For those companies familiar with the Standard Industrial Classification (SIC), the 1972 SIC number of numbers are given after each title. Note that the SIC definition here applies to **each field of research and development effort**, and not necessarily to the overall code in which your company's manufacturing output is classified.

Product Group

Atomic Energy Devices — Applied Research and Development on atomic energy devices should be included with research and development as classified in the categories listed on lines 1 — 34. Examples of the fields of research and development activities on atomic energy devices and the product groups in which such activities should be reported are as follows:

Activity	Product Group No.
Radioactive isotopes and other radiation sources	3
Partially fabricated reactor fuel element materials and control rods	11
Nuclear reactors; reactor components and equipment; core structurals; heat exchangers and condensers; valves; complete reactor fuel elements and control rods for use in propulsion, power plants, and other; and atomic waste casks	14
Fuel handling equipment, control rod drive mechanism and components for power plants, propulsion, and other; pressurizers, components, and auxiliary equipment; and pumps	20
Accessory instrumentation for reactor control	22
Atom smashers (particle accelerators)	24
Hot laboratory equipment, special instrumentation	31

1. Foods and Kindred Products (SIC 20) — Foods and beverages for human consumption and certain related products such as vegetable and animal fats and oils, and prepared feeds for animals and fowls.

2. Textile Mill Products (SIC 22) — Mill preparation of fibers and mill manufacture of yarn, thread, twine etc; manufacture of woven and knit fabric, carpets and rugs; dyeing and finishing fiber, yarn, and knit apparel; coating, waterproofing, or otherwise treating fabric; the manufacture of knit apparel; other finished articles from yarn, felt goods, lace goods, bonded fiber fabrics, and miscellaneous textiles.

3. Basic Industrial Inorganic and Organic Chemicals (SIC 281 and 286) — Includes alkalies and chlorine, industrial gases, inorganic pigments, and industrial inorganic chemicals not elsewhere classified. Also includes industrial organic chemicals including gum and wood chemicals, cyclic crudes, and cyclic intermediates, dyes, and organic pigments, and other industrial organic chemicals n.e.c. Includes radioactive isotopes and other radiation sources.

4. Plastics Materials and Synthetic Resins, Synthetic Rubber, Synthetic and Other Manmade Fibers (SIC 282) — Includes cellulosic and noncellulosic fibers. Excludes glass which should be included in product group 11.

5. Drugs (SIC 283) — Medicinal chemicals, biological and botanical products, and pharmaceutical preparations.

6. Agricultural Chemicals (SIC 287) — Fertilizers, agricultural pesticides, and other agricultural chemicals.

7. All Other Chemicals (balance of SIC 28) — Explosives, soaps, glycerins, detergents and cleaning preparations, paints and varnishes, toilet preparations, and miscellaneous chemical products.

8. Petroleum Refining and Related Industries, Oil and Gas Extraction (SIC 13 and 29) — Excludes geological and geophysical exploration activities.

9. Rubber and Miscellaneous Plastics Products (SIC 30) — Fabricated rubber such as industrial and mechanical rubber goods and fabricated plastics products.

10. Stone, Clay, Glass, and Concrete Products (SIC 32) — Ceramics, glass, clay products, abrasives and asbestos products, cement, stone products, concrete products, and other nonmetallic mineral products.

11. Primary Ferrous Products (SIC 331, 332, 3399, and 3462) — Products of blast furnaces, steel works, rolling and finishing mills, iron and steel castings and forgings. Includes partially fabricated reactor fuel element materials and control rods.

12. Primary and Secondary Nonferrous Metals (balance of SIC 33 and 3463) — Primary and secondary smelting and refining of nonferrous metals, rolled, drawn, and extruded nonferrous metals products, castings and forgings.

13. Ordnance, Except Missiles (SIC 348, 3795) — Artillery, small arms, ammunition, tanks and parts, etc.

14. Fabricated Metal Products (SIC 34 except 3462, 3463, and 348, ferrous and nonferrous forgings, ordnance) — Tinwear, hand tools, nonelectric heating apparatus, fabricated structural metal products, metal stampings, fabricated wire products, etc., core structurals (barrels, cans, boxes plates, etc.); heat exchangers, steam and barometric condensers; and valves. Nuclear reactors; reactor components and equipment.

15. Engines and Turbines (SIC 351) — Steam engines, steam, gas and hydraulic turbines, diesel and other internal combustion engines, n.e.c.

16. Farm and Garden Machinery and Equipment (SIC 352) — Farm machinery, including tractors for farm use.

17. Construction, Mining, and Material Handling Machinery and Equipment (SIC 353) — Construction mining, and oil field machinery and equipment, elevators, conveyors, hoists, industrial trucks, tractors, trailers, and stackers.

18. Metal Working Machinery and Equipment (SIC 354) — Machine tools, dies, machine tool accessories, rolling mill machinery, power driven hand tools, wire fabricating machinery and equipment, and automobile maintenance machinery and equipment.

19. Office, Computing, and Accounting Machines (SIC 357) — Electronic computing equipment; calculating and accounting machines; typewriters; other computing and office machines, (except laboratory scales and balances).

20. Other Machinery, Except Electrical (balance of SIC 35) — Special industrial machinery, except metalworking, such as food products machinery, textile and paper industries machinery, general industrial machinery and equipment, and miscellaneous machinery except electrical. Includes pumps, air and gas compressors, and industrial process furnaces and ovens. Includes atomic fuel holding equipment; control rod drive mechanism and components for use on nuclear reactors.

21. Electric Transmission and Distribution Equipment (SIC 361 and 3825) — Electric measuring instruments and test equipment, power distribution and specialty transformers, switchgear and switchboard transformers, etc.

22. Electrical Industrial Apparatus (SIC 362) — Electric motors and generators, motor starters and controls, welding apparatus, carbon and graphite brushes, electrodies. Nonelectronic capacitors, condensers, and rectifiers. Accessory instrumentation reactor control.

23. Radio and Television Receiving Equipment, Except Communication Types (SIC 365) — Radios and television sets, home recorders, prerecorded magnetic tapes, microphones, speaker systems, turntables, phonograph records, etc.

24. Communication Equipment (SIC 366) — Telephone and telegraph apparatus, radio and television transmitting, signaling, and detection equipment and apparatus, radar equipment, electronic sighting devices, atom smashers, etc.

25. Electronic Components and Accessories (SIC 367) — Semiconductors, computer logic modules, computer chips, solid state electronic devices, integrated circuits, electronic capacitors, transformers, connectors, cathode ray tubes, nuclear detectors, solar cells, solid state photovoltaic devices, etc.

26. Other Electrical Machinery Equipment and Supplies (balance of SIC 36) — Household appliances, electric lighting and wiring equipment, and miscellaneous electrical machinery equipment and supplies.

27. Missiles (SIC 376) — Including frames or structures, launching and handling support equipment and work on the missile system as a whole. Exclude electronic guidance control subassemblies and radar which should be reported in product group 24. Exclude rocket motors which would be reported in product group 29.

28. Space Vehicles (SIC 376 part) — Include frames or structures, launching and handling support equipment and work on the space vehicle as a whole.

29. Aircraft and Parts (SIC 372) — Piloted and unpiloted aircraft and parts of all types, including engines and auxiliary equipment such as landing gear, de-icing equipment, and other auxiliary equipment specifically adopted for aircraft. Exclude radar and radio equipment and electronic sighting devices which should be reported in product group 24. Exclude aeronautical instruments which should be reported in product group 32.

30. Motor Vehicles and Equipment (SIC 371) — Applied research and development related to motor vehicles such as ambulances, fire engines, personnel carriers, amphibian motor vehicles, and truck and automobile trailers, and to motor vehicle equipment, etc.)

31. Other Transportation Equipment (balance of SIC 37 except 3795) — Shipbuilding, boatbuilding and repairing, railroad equipment, motorcycles, bicycles, and parts, etc. Exclude tanks and tank components which are in product 13.

32. Scientific and Mechanical Measuring Instruments (SIC 381, 382) — Engineering, laboratory, scientific, and research instruments, and associated equipment; automatic controls for regulating residential and commercial environments and appliances; industrial instruments for measurement, display, and control of process variables; nonelectric fire detecting systems; totalizing fluid meters and counting devices; instruments for measuring and testing electricity and electrical signals.

33. Optical, Surgical, Photographic, Timing and Other Instruments (SIC 383-87) — Optical instruments and lenses; surgical and medical instruments and apparatus; dental equipment and supplies; ophthalmic goods including contact lenses; optical fire control equipment; photographic equipment and supplies including film and motion picture apparatus; watches, clocks, clockwork operated devices and parts, appliance timers, chronometers.

► **Item 9 — Cost of Research and Development Performed Within the Company, by State** — Report the cost of research and development for each state in which your company has research and development laboratories or facilities. It is not necessary to calculate separately individual assignments which may be made outside the home state of a particular research staff. As much as 10 percent of the total may, if desired, be reported in line 52 as "Not distributed by state."

► **Item 10 — Research and Development by Functional Category**

Energy Research and Development — Include all spending for research and development to increase energy resources or capabilities, including the development of energy equipment. If R&D spending is for joint or multiple purposes, estimate and report the portion of cost incurred due to the energy purpose. Do not include any of project cost if the **primary** purpose of the project is other than energy R&D. Energy R&D can include costs of R&D projects (both product and process) on exploration, extraction, transportation, processing, storage, generation (including conversion), distribution, conservation, etc., of present, new, or improved forms of energy. Record energy R&D spending according to type of energy.

► **Item 10B4 — Coal R&D Activities** are to be Assigned into Subcategories. "Synthetic fuels" includes programs designed to convert coal to gaseous and liquid products. "Mining" is composed of programs for developing equipment and techniques to improve the productivity and recovery rates of coal mining.

► **Item 10C3 — "Conservation and utilization"** includes R&D activities undertaken to reduce consumption either at the point of energy use or in the transmission, transportation, storage, and conversion of energy. Examples of such are research and development undertaken primarily to reduce fuel consumption in manufacturing, to improve the efficiency of transportation of energy products, or to produce an end product which is more efficient in energy consumption.

► **Item 10D — "All other energy"** includes areas such as wind, waste, hydroelectric, etc. Also include in this category the development of energy equipment which cannot be readily classified in Items 10A to 10C. In a limited number of cases, the separation of joint (multiple) costs which is in the preceding paragraphs may not be feasible. In this circumstance, include here the total project cost if the primary purpose of a project is energy research and development.

► **Pollution Abatement Research and Development** — Includes R&D spending for the purpose of reducing or eliminating the emission of pollutants. "Pollution" refers to the emissions of pollutants to the outside of a firm's (or household's) property or activities; "abatement" includes prevention, treatment or recycling. Exclude spending to contribute to environmental aesthetics, to increase equipment durability in corrosive environments, to conserve energy (include as energy R&D above) and natural resources, or to increase employee comfort, safety, and health.

If the purpose of the R&D project is pollution abatement only, include the total expenditures on the R&D project in Item 10J and in the appropriate subcategories. If the project has mixed purposes, estimate and report where possible only the portion of costs incurred due to the pollution abatement purpose. If a separation of joint costs cannot be made, then decide whether the R&D project is primarily (more than 50 percent) for pollution abatement. If so, then include the total cost of the project in Item 10J and in the appropriate subcategories. If the project is **not** primarily for pollution abatement, then exclude all of the project cost. Exclude project costs if expected pollution abatement benefits are incidental. (Incidental benefits are those obtained at no extra cost.)

- ▶ **Item 10F — Air** — 1. Automotive emissions includes all R&D efforts undertaken to reduce exhaust emissions from automobiles. 2. Electric power plant emissions includes efforts directed toward reducing airborne emissions from electric power plants. 3. "All other" includes efforts directed at removing sulfur oxide, nitrogen oxides and particulates, and other fossil-fuel pollutants from the atmosphere.
- ▶ **Item 10G — Water** — Includes R&D spending on water recirculation or thermal pollution abatement, etc.
- ▶ **Item 10H — Solid Waste** — Includes R&D spending on waste compacting devices, etc.
- ▶ **Item 10I — Other** — Includes R&D spending on pollution abatement from noise and radiation, etc.
- ▶ **Item 11 — Product Versus Process Applied Research and Development** — Allocate the total applied research and development dollar figures of Item 4B3 column 4, to either product or process research and development, Items 11A and 11B. Include in your allocation any company overhead associated with the applied research and development that was included in the dollar figures of Item 4B3.

If you are unsure whether the research and development is for a process or a product, refer to the definitions for each item below. If the expenditures are unclassifiable as either product or process, enter the cost of such research in the unclassifiable category, Item 11C.

- ▶ **Item 11A — Product Applied Research and Development Costs** — Costs for applied research and development oriented towards goods that have the potential for sale to the public or to other firms. R&D work should be classified as a cost for product research and development. If it clearly involves making a product feasible or is an integral part of product modification, rather than affecting the efficiency with which the product is made.
- ▶ **Item 11B — Process Applied Research and Development Costs** — Costs for applied research and development devoted to reducing costs, increasing production efficiency, or increasing output by improving the manufacturing process.
- ▶ **Item 11C — Unclassifiable Applied Research and Development Costs** — Applied research and development costs which cannot be classified as product or process, based upon the above definitions. Do not include in this item company **overhead costs** related to projects which can be classified into

product or process research and development. These costs should be in Items 11A and 11B and NOT considered an unclassifiable expense for Item 11C.

- ▶ **Item 11D — Total** — Add together the totals for Items 11A through 11C and enter amounts in the appropriate columns.
- ▶ **Item 12 — Long Versus Short Term Research and Development Costs** — Allocate the total R&D dollar figures of Item 4C columns 2 and 4 ("FEDERAL" and "TOTAL"), based on the actual or estimated future life of each of your projects in the R&D cycle, into three time period categories. A distinction should be made between continuing programs and specific projects. While programs in broad areas may continue for long periods of time, you are asked to treat independently specific projects with separate budgets, definable goals, and project lives, except where projects are sequential, i.e., one depending on the other to reach a specified goal. Treat the sequence as a single project.
- ▶ **Item 12A — Less Than or Equal to 2-Year Project Life** — Include the current year's costs for all projects whose total life in the R&D cycle is expected to be less than or equal to 2 years from inception to completion or termination. Completion refers to the R&D phase only. At the time production planning, design, and engineering begin, research and development is usually over.
- ▶ **Item 12B — 2- to 5-year Project Life** — Includes current year cost of all projects whose total life in the R&D cycle has been or is expected to be more than 2 years but less than or equal to 5 years.
- ▶ **Item 12C — More than 5-Year Project Life** — Include the current year cost of all projects whose total life in the R&D cycle has been or is expected to be more than 5 years.

Company overhead or other costs included in Item 4B3 should be allocated to Items 12A, 12B, or 12C. The sum of 12A, 12B, and 12C should be equal to Item 4C.

- ▶ **Section III — RESEARCH AND DEVELOPMENT PERFORMED OUTSIDE THE COMPANY** — (Research and development performed outside the company is not included in Item 4).
- ▶ **Item 13 — Total Company Funds Spent for Research and Development Activities Performed Outside the Company Within the United States** — Includes payments for research and development activities in the form of contracts, grants, fellowships, etc., made to other industrial firms, commercial laboratories, consultants, educational institutions, hospitals, research institutions, etc. (Please exclude subcontracting of R&D contracts received from the Federal Government or other companies.)
- ▶ **Item 14 — Total Company Funds Spent for Research and Development Activities Performed by Foreign Subsidiaries Outside the United States** — Report the amount of research and development financed by the U.S. parent or its foreign subsidiaries and performed by company R&D laboratories, branch plants, divisions, etc., or by other organizations, located outside the United States. This item excludes R&D activities performed by foreign subsidiaries which were financed by foreign governments or other outside organizations.

NOTE — Foreign subsidiaries are those outside the 50 States or the District of Columbia.

NOTICE — Your report to the Census Bureau is confidential by law (title 13, U.S. Code). It may be seen only by sworn Census employees and may be used only for statistical purposes. The law also provides that copies retained in your files are immune from legal process.

CENSUS
USE
ONLY

FORM **RD-1**
(6-24-87)

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
COLLECTING AND COMPILING AGENT FOR
THE NATIONAL SCIENCE FOUNDATION

**SURVEY OF INDUSTRIAL RESEARCH AND
DEVELOPMENT DURING 1987**

SURVEY CODE

4001

INDUSTRY CODE

WEIGHT

STATE

ADDRESS

SIC CODE

In correspondence pertaining to this report refer
to this **CENSUS FILE NUMBER (11 digits)**

RETURN
TO

Bureau of the Census
1201 East Tenth Street
Jeffersonville, Indiana 47132

Name of person who supplied 1986 data

Date supplied in items 1A and 1B and in
item 4C, columns 2 and 4, for 1987 on this
form, will satisfy the mandatory reporting
requirement of Census Form MA-121 (title
13, U.S. Code). Your cooperation on the
other items is essential to make the results
of this survey comprehensive, accurate,
and timely.

PLEASE RETURN THIS COPY

(Please correct any error in name and address, including ZIP code.)

GENERAL INSTRUCTIONS

- Please complete this form and return within 60 days in the envelope provided. Retain the file copy for your records. **THIS REPORT SHOULD COVER YOUR ENTIRE COMPANY, INCLUDING ALL SUBSIDIARIES, UNLESS OTHERWISE DESIGNATED.**
- Enter 0 (zero) where appropriate rather than leaving a blank space.
- Reasonably accurate estimates are acceptable.
- Figures for 1985 are those reported by your company in that year. They are included solely to assist you in reporting 1987 data.
- Figures for 1986 are those reported by your company last year. **THE 1986 FIGURES SHOULD BE REVISED, IF NECESSARY, TO BE COMPARABLE WITH 1987 DATA.**
- Explain in "Remarks" on the back page any substantial increases or decreases in 1987 figures over 1986 (e.g., new government contracts, acquisitions, mergers, divestitures, etc.)

PLEASE READ ENCLOSED INSTRUCTIONS BEFORE COMPLETING THIS FORM

SECTION I — GENERAL COMPANY DATA

Item 1 — DOMESTIC SALES, RECEIPTS, AND EMPLOYMENT FOR COMPANY

A. Domestic net sales and receipts of this company (Thousands of dollars)

B. Total domestic company employment in all activities during the pay period which includes the 12th of March 1986 and 1987

	1986	1987
101		102
103		104

SECTION II — RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY IN THE UNITED STATES
(Exclude R&D financed by the company but performed by others. Report such R&D in section III.)

Item 2 — RESEARCH AND DEVELOPMENT EXPENDITURES

Are research and development expenditures for entire domestic company, including subsidiaries, reported on this form?

☐ YES ☐ NO — Please explain in remarks
or on transmittal letter

Item 3 — NUMBER OF SCIENTISTS AND ENGINEERS INVOLVED IN RESEARCH AND DEVELOPMENT ACTIVITIES

Apportion on a full-time equivalent basis. (See instruction manual)

A. Federal research and development

B. Company and other research and development

C. TOTAL (Sum of A and B)

	January 1987	January 1988
111		
112		
113		114

Item 4 — COSTS INCURRED FOR RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY BY MAJOR TYPE AND SOURCE OF FUNDS

Include R&D depreciation and overhead; exclude R&D capital expenditures. (See instruction manual)

A. Basic research If "None," please mark (X) ☐

B. Applied research and development

1. Applied research

2. Development

3. TOTAL (Sum of lines 1 and 2)

C. TOTALS (Sum of A and B3)

D. 1988 TOTALS

E. Company and other funds, except Federal, budgeted for the year 1988

Thousands of dollars			
1986	1987	1987	1987
TOTAL research and development (1)	Federal funds (2)	Company and other funds, except Federal (3)	TOTAL (Sum of columns 2 and 3) (4)
201	202	203	204
211	212	213	214
221	222	223	224
231	232	233	234
	242	243	244
	252	253	254
		263	

Item 5 — COSTS INCURRED FOR FEDERAL RESEARCH AND DEVELOPMENT BY PRINCIPAL AGENCY

(Breakdown of item 4C, column 2)

1. Department of Defense

2. National Aeronautics and Space Administration

3. Department of Energy

4. All other Federal Agencies

5. TOTAL COST (Sum of 1, 2, 3, and 4)

Thousands of dollars		
1985	1986	1987
	N	301
	O	302
	T	303
	A	304
	S	305
	K	
	E	
	D	

Item 6 — COSTS INCURRED FOR RESEARCH AND DEVELOPMENT PERFORMED WITHIN THIS COMPANY BY MAJOR TYPE OF EXPENSE

A. Wages and salaries of research and development personnel (Include scientists and engineers, technicians, secretaries, and other personnel)

B. Costs of materials and supplies consumed (Do not include in this item components, models, and other materials supplied by other research organizations)

C. Other costs (Include service and supporting costs, R&D depreciation, and share of overhead)

D. TOTAL COSTS (Sum of A through C) (Same as item 4C, column 4)

Thousands of dollars		
1985	1986	1987
	N	311
	O	312
	T	313
	A	314
	S	
	K	
	E	
	D	

PLEASE CONTINUE ON NEXT PAGE

SURVEY OF INDUSTRIAL RESEARCH AND
DEVELOPMENT DURING 1987U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
COLLECTING AND COMPILING AGENT FOR
THE NATIONAL SCIENCE FOUNDATIONRefer to this
CENSUS FILE NUMBER
in any correspondence
pertaining to this reportSECTION II — RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY IN THE UNITED STATES Continued
(Exclude R&D financed by the company but performed by others. Report such R&D in section III.)

Item 7 — FIELDS OF BASIC RESEARCH

Allocate the total reported in item 4A for basic research into the following fields of science and engineering.

A. Chemistry

B. Engineering (Including metallurgy)

C. Geological sciences

D. Mathematics

E. Computer sciences

F. Physics

G. Astronomy

H. Atmospheric sciences

I. Oceanography

J. Biological sciences

K. Clinical medical sciences

L. Other — Specify

M. TOTAL BASIC RESEARCH COST (Same as item 4A, column 4)

Thousands of dollars

1985	1986	1987
	↑	401
		402
		407
		408
	N	409
	O	410
	T	411
		412
	A	413
	S	414
	K	415
	E	417
	D	418

Item 8 — APPLIED RESEARCH AND DEVELOPMENT BY PRODUCT GROUP

Allocate the total reported in 4B, line 3, applied research and development, into the following product groups which represent the END PRODUCT for the firm.
(See instructions on how to classify the applied research and development)

1. Food and kindred products

2. Textile mill products

3. Industrial inorganic and organic chemicals

4. Plastics materials and synthetic resins, rubber, and fiber

5. Drugs

6. Agricultural chemicals

7. All other chemicals

8. Petroleum refining

9. Rubber and miscellaneous plastics products

10. Stone, clay, glass, and concrete products

11. Primary ferrous products

12. Primary and secondary nonferrous metals

13. Ordnance, except missiles

14. Fabricated metal products

15. Engines and turbines

16. Farm machinery and equipment

17. Construction, mining, and materials handling machinery

18. Metalworking machinery and equipment

19. Office, computing and accounting machines

20. Other machinery, except electrical

21. Electric transmission and distribution equipment

22. Electrical industrial apparatus

23. Radio and television receiving sets, except communication types

24. Communications equipment

25. Electronic components and accessories

26. Other electrical machinery equipment and supplies

27. Missiles

28. Space vehicles

29. Aircraft and parts

30. Motor vehicles and equipment

31. Other transportation equipment

32. Scientific and mechanical measuring instruments

33. Optical, surgical, photographic, and other instruments

34. Other — Specify

35. TOTAL APPLIED RESEARCH AND DEVELOPMENT COSTS (Same as item 4B3, columns 2 and 4)

Thousands of dollars

1985		1986	1987	
Federal	Total		Federal	Total
		↑	501	502
			503	604
			505	506
			507	508
			509	510
			511	512
			513	514
			515	516
			517	516
			519	520
			521	522
			523	524
			525	525
			527	526
			529	530
		N	531	532
		O	533	534
		T	535	536
			537	538
		A	539	540
		S	541	542
		K	543	544
		E	545	545
		D	547	546
			549	550
			553	554
			555	555
			557	556
			559	550
			561	562
			563	564
			565	566
			567	568
			571	572
			573	574

Item 9 — COST OF RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY, BY STATE

Allocate the totals reported in item 4C, columns 2 and 4, by the States in which your various research and development laboratories or facilities are located. Estimate the costs associated with each State. If necessary, you may report up to 10 percent of your totals as "Not distributed by State."

Thousands of dollars						Thousands of dollars					
State	1985		1986	1987		State	1985		1986	1987	
	Federal	Total		Federal	Total		Federal	Total		Federal	Total
1. AL			↑	601	502	27. MT			↑	653	654
2. AK				603	504	28. NE				655	656
3. AZ				605	606	29. NV				657	658
4. AR				607	606	30. NH				659	660
5. CA				609	610	31. NJ				661	662
6. CO				611	612	32. NM				663	664
7. CT				613	614	33. NY				655	656
8. DE				615	616	34. NC				667	666
9. DC				617	618	35. ND				659	670
10. FL			N	619	620	36. OH				671	672
11. GA			O	621	622	37. OK			N	673	674
12. HI			T	623	624	38. OR			O	675	676
13. ID				625	626	39. PA			T	677	676
14. IL			A	627	628	40. RI				679	680
15. IN			S	629	630	41. SC			A	661	662
16. IA			K	631	632	42. SD			S	663	664
17. KS			E	633	634	43. TN			K	665	666
18. KY			D	635	636	44. TX			E	667	668
19. LA				637	638	45. UT			D	669	690
20. ME				639	640	46. VT				691	692
21. MD				641	642	47. VA				693	694
22. MA				643	644	48. WA				695	696
23. MI				645	646	49. WV				697	598
24. MN				647	548	50. WI				699	700
25. MS				649	650	51. WY				701	702
26. MO			↓	651	652	52. *				703	704
53. TOTAL COSTS (Same as item 4C, columns 2 and 4)										705	706

**SURVEY OF INDUSTRIAL RESEARCH AND
DEVELOPMENT DURING 1987**

SECTION II — RESEARCH AND DEVELOPMENT PERFORMED WITHIN THE COMPANY IN THE UNITED STATES — Continued
(Exclude R&D financed by the company but performed by others. Report such R&D in section III.)

Item 10 — RESEARCH AND DEVELOPMENT BY FUNCTIONAL CATEGORY

Of the total reported in item 4C, columns 2 and 4, report the following functional categories.

ENERGY RESEARCH AND DEVELOPMENT

Include the project cost or portion of project cost incurred for the purpose of increasing energy resources or capabilities. Include cost by type of energy.

A. Total nuclear

1. Fission
2. Fusion

B. Total fossil fuels

1. Oil
2. Gas
3. Shale
4. Coal
a. Synthetic fuels
b. Mining
c. All other
5. Other fossil fuels

C. Total geothermal, solar, conservation end utilization

1. Geothermal
2. Solar
3. Conservation end utilization

D. All other energy

E. Total of A through D

Thousands of dollars					
1989		1987		1989	
Federal funds	Total funds	Federal funds	Total funds	Projected Federal funds	Projected total funds
801	802	803	804	805	806
NOT ASKED	NOT ASKED	807	808	809	810
		811	812	813	814
815	816	817	818	819	820
N	N	821	822	823	824
O	O	825	826	827	828
T	T	829	830	831	832
A	A	833	834	835	836
S	S	837	838	839	840
K	K	841	842	843	844
E	E	845	846	847	848
D	D	849	850	851	852
853	854	855	856	857	858
NOT ASKED	NOT ASKED	859	860	861	862
		863	864	865	866
		867	868	869	870
871	872	873	874	875	876
877	878	879	880	881	882

POLLUTION ABATEMENT RESEARCH AND DEVELOPMENT

Include the project cost or portion of the project cost incurred for the purpose of designing pollution abatement products or product characteristics or of designing pollution abatement features into processes. Include cost by form of pollution to be abated.

F. Air

1. Automotive emissions
2. Electric power plant emissions
3. All other

G. Water

H. Solid waste

I. Other

J. Total of F through I

Thousands of dollars					
1989		1987		1989	
Federal funds	Total funds	Federal funds	Total funds	Projected Federal funds	Projected total funds
N	N	901	902	903	904
O	O				
T	T	905	906	907	908
		909	910	911	912
A	A	913	914	915	916
S	S	917	918	919	920
K	K	921	922	923	924
E	E	925	926	927	928
D	D	929	930	931	932
		933	934	935	936

Item 11 — PRODUCT VERSUS PROCESS APPLIED RESEARCH AND DEVELOPMENT

Allocate the total applied research and development dollar figures of item 4B3, column 4, to product, process, or unclassifiable R&D. (If company records do not reveal exact data for this item, please submit your best estimate for the allocation.)

A. Product research and development

B. Process research and development

C. Unclassifiable as to product or process

D. Total (Sum of A through C)

Thousands of dollars		
1985	1986	1987
	NOT ASKED	951
		952
	AS	953
	KE	954

Item 12 — LONG VERSUS SHORT TERM RESEARCH AND DEVELOPMENT COSTS

Allocate the total R&D dollar figures of item 4C, columns 2 and 4, "Federal" and "Total" based on the actual and estimated future life of each of your projects in the R&D cycle, into the following three categories: (If company records do not reveal exact data for this item, please submit your best estimate for the allocation.)

A. Projects whose total life in the R&D cycle is less than or equal to 2 years

B. Projects whose total life in the R&D cycle is more than 2 years but less than or equal to 5 years

C. Projects whose total life in the R&D cycle is more than 5 years

Thousands of dollars					
1985		1986	1987		
Federal	Total		Federal	Total	
		NOT ASKED	951	952	
			953	954	
		AS	955	956	
		KE	957	958	

SECTION III — RESEARCH AND DEVELOPMENT PERFORMED OUTSIDE THE DOMESTIC COMPANY WITH COMPANY FUNDS
(Not included in item 4.)

Item 13 — TOTAL COMPANY FUNDS FOR RESEARCH AND DEVELOPMENT ACTIVITIES FINANCED BY THE COMPANY BUT PERFORMED BY OTHERS OUTSIDE THE COMPANY WITHIN THE UNITED STATES

Include other industrial firms, colleges and universities, nonprofit organizations, etc. Exclude subcontracting of Federal government and other contracts. (See instruction manual)

Item 14 — TOTAL COMPANY FUNDS SPENT FOR RESEARCH AND DEVELOPMENT ACTIVITIES PERFORMED BY FOREIGN SUBSIDIARIES OR BY OTHER ORGANIZATIONS OUTSIDE THE UNITED STATES

Thousands of dollars		
1985	1986	1987
	NOT ASKED	971
		972
	1986	1986
972		973

Item 15 — STATUS OF THIS COMPANY ON DECEMBER 31, 1987

A. Was the company listed in the address label owned or controlled by another company on December 31, 1987? ☐ Yes — Complete item 15B ☐ No

B. New owner information

Name _____ Date acquired _____
985
Address (Number and street) _____
987
City _____ State _____ ZIP code _____
988 _____ 989 _____ 990 _____

REMARKS — If more space is required, continue on reverse.

891

Item 19 — CERTIFICATION — This report is substantially accurate and has been prepared in accordance with instructions.

Key	Name of person to contact regarding this report — Print or type	Mo.	Day	Year
992				
	Telephone	Signature of authorized official		
	Area code Number Extension			
893				

FORM **RD-1A**
(6-24-87)U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
COLLECTING AND COMPILING AGENT FOR
THE NATIONAL SCIENCE FOUNDATION**SURVEY OF INDUSTRIAL RESEARCH
AND DEVELOPMENT DURING 1987****RETURN
TO**Bureau of the Census
1201 East Tenth Street
Jeffersonville, IN 47132**GENERAL INSTRUCTIONS**

Please complete and return this form in the envelope provided within 60 days. Retain the file copy for your records. This report should cover your entire company, including all subsidiaries and affiliates, unless otherwise designated.

Enter "None" where appropriate rather than leaving a blank space.

Reasonably accurate estimates are acceptable.

PLEASE READ INSTRUCTIONS AND DEFINITIONS ON REVERSE SIDE BEFORE COMPLETING THIS FORM.

NOTICE — Your report to the Census Bureau is **confidential** by law (title 13, U.S. Code). It may be seen only by sworn Census employees and may be used only for statistical purposes. The law also provides that copies retained in your files are **immune from legal process**.

Item 1 — NAME AND ADDRESS OF COMPANY — Please correct any error in name and address, including ZIP Code

PLEASE RETURN THIS COPY

Data supplied in item 2 and in item 4A, columns 2 and 4, for 1987 on this form will satisfy the mandatory reporting requirement of Census Form MA-121 (title 13, U.S. Code).

Item 2 — SALES AND EMPLOYMENT FOR COMPANY**1986****1987***Thousands of dollars*

101

102

A. Domestic net sales and receipts of this company*Number*

103

104

B. Total domestic company employment in all activities during the pay period which includes the 12th of March 1986 and 1987**Item 3 — NUMBER OF RESEARCH AND DEVELOPMENT SCIENTISTS
AND ENGINEERS (See instructions on reverse side)****January 1987****January 1986**

113

114

**Item 4 — COST OR RECEIPTS FOR
RESEARCH AND
DEVELOPMENT PERFORMED
WITHIN THE COMPANY***Thousands of dollars*Federal
funds
(2)Company and
other funds,
except Federal
(3)**TOTAL**
(Sum of
columns 2
(4) and 3)**A.** 1987 TOTALS

242

243

244

B. 1986 TOTALS

252

253

254

C. Company and other funds, except Federal, budgeted for the year 1988

263

**Item 5 — TOTAL COMPANY FUNDS SPENT FOR RESEARCH AND
DEVELOPMENT ACTIVITIES PERFORMED OUTSIDE
THE COMPANY BUT WITHIN THE UNITED STATES****1987***Thousands of dollars*

971

Item 6 — STATUS OF THIS COMPANY ON DECEMBER 31, 1987**A.** Was the company listed in item 1 owned or controlled by another company on December 31, 1987?☐ Yes — Complete item 6B☐ No**B.** New owner informationName
985Date acquired
986Address (Number and street)
987City
988State
989ZIP code
990

INSTRUCTIONS AND DEFINITIONS FOR SURVEY OF INDUSTRIAL RESEARCH AND DEVELOPMENT DURING 1987

General Instructions — Figures reported on sales and employment (items 2A and B) should cover your entire company, including all subsidiaries and affiliates, unless otherwise designated. The sales figures should exclude excise taxes and other discounts and allowances such as freight charges. The cost figure reported should cover the calendar years if at all possible. Please report your employment data (items 2B and 3) for the period prescribed on this report form.

Geographic Area Covered — The data are intended to relate to business firms in the fields of manufacturing, minerals, and other economic areas which operate one or more establishments in one or more of the 50 States or the District of Columbia.

Scientists and Engineers — Scientists and engineers for this survey are defined as all persons engaged in scientific or engineering work at a level which requires a knowledge of physical or life sciences or engineering or mathematics equivalent at least to that acquired through completion of a 4-year college course with a major in these fields, regardless of whether they held a college degree in the field.

Report the number assigned to research and development. If the scientists and engineers work on research and development and other activities, the figure reported should be based on the proportion of the total time that is devoted to research and development.

Research and Development — Research-development includes basic and applied research in the sciences (including medicine) and in engineering, and design and development of prototype products and processes. It does not include quality control, routine product testing, market research, sales promotion, sales service, research in the social sciences or psychology, or other nontechnological activities or technical service.

Cost of Research and Development Work Performed Within the Company — All costs incurred within the company for wages and salaries, direct material costs, services and supporting costs, and an appropriate share of company overhead to conduct research and development activities. If you did research and development for others, include the total amount charged for such work.

Under Federal funds, include research and development in procurement as well as research and development contracts and research and development subcontracts. Exclude research and development subcontracted to others.

If the company has a separate research-development organization, please exclude the estimated cost of any nonresearch-development activities conducted by that unit; include the approximate cost of research-development activities of company laboratories of technical groups not part of the research organization.

Company Funds Spent in Research and Development Done Outside Your Company — Include in this item payments, in the form of contracts, grants, fellowships, etc., made to commercial laboratories and consultants, educational institutions, hospitals, and research institutions for research and development activities. Please do not include subcontracting of Federal Government contracts or contracts received from other companies. (To do so would cause duplication in the total figure for the survey.)

If you have questions regarding reporting problems on this form, please write to the Bureau of the Census, Industry Division, Washington, D.C. 20233 or call Area Code (301) 763-5598.

arks

Item 7 — CERTIFICATION — This report is substantially accurate and has been prepared in accordance with instructions.

Name of person to contact regarding this report

Telephone (Area Code, number, extension)
993

Address (Number and street, city, State, ZIP Code)

Name of company

Address (Number and street, city, State, ZIP Code)

Signature of authorized official

Title

Date

FORM **MA-121**
(6-30-87)U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS**COMPANY SUMMARY OF
RESEARCH AND
DEVELOPMENT****1987****RETURN
TO****Bureau of the Census
1201 East Tenth Street
Jeffersonville, IN 47132****NOTICE** — Response to this inquiry **is required by law (title 13, U.S. Code, sections 131, 182, 224, and 225)**. By section 9 of the same law, your report to the Census Bureau is **confidential**. It be seen only by sworn Census employees and may be used only for statistical purposes. The law provides that copies retained in your files are **immune from legal process**.

(Please correct any error in name and address including ZIP Code)

Please complete and return this form in the return envelope not later than 15 days after you receive it. Companies with no research and development expenditures should so state in the "Remarks" section, fill in items 1a and 1b, sign, and return the form.

PLEASE RETURN THIS COPY**PLEASE READ INSTRUCTIONS ON REVERSE SIDE BEFORE COMPLETING YOUR REPORT****Item 1 — SALES AND EMPLOYMENT FOR COMPANY****1987**
(Thousands of dollars)

102

a. Domestic net sales and receipts of this company**Number**

104

b. Total domestic company employment in all activities during the pay period which includes the 12th of March 1987**1987**

(Thousands of dollars)

Federal funds

(2)

**Company
and other funds,
except Federal**
(3)**TOTAL**
(Sum of
columns 2 and 3)
(4)

242

243

244

**Item 2 — COST OR RECEIPTS FOR RESEARCH AND
DEVELOPMENT PERFORMED WITHIN THE
COMPANY DURING 1987****Remarks**

991

Item 3 — STATUS OF THIS COMPANY ON DECEMBER 31, 1987**a. Was the company listed in item 1 owned or controlled by another company on December 31, 1987?**☐ Yes — Complete
item 3B☐ No**b. New owner information****Name**
985**Date acquired**
986**Address (Number and street)**
987**City**
988**State**
989**ZIP Code**
990

GENERAL INSTRUCTIONS

A report should be filed by each company receiving a copy of this form. If your company does not conduct research and development, so state in remarks, fill in items 1a and 1b, sign, and return the form. If you have questions regarding reporting problems on this form, please write to the Bureau of the Census, Industry Division, Washington, D.C. 20233.

Report for your entire company — Research and development activities for your entire domestic company should be reported.

Period covered by report — The cost figure reported should cover the calendar year if at all possible. However, fiscal year data are acceptable, provided your fiscal year ends between September and March.

DEFINITION OF RESEARCH AND DEVELOPMENT

Research-development includes basic and applied research in the sciences (including medicine) and in engineering, and design and development of prototypes, products, and processes. It does not include quality control, routine product testing, market research, sales promotion, sales service, research in the social sciences or psychology, or other nontechnological activities or technical services.

SPECIFIC INSTRUCTIONS BY ITEM

Item 1 — Sales and Employment for Company.

In item 1a, report the net billings of this company and its subsidiaries to customers outside the company. (Exclude domestic intra-company transfers and sales by foreign subsidiaries. Include the transfers to such foreign subsidiaries, however.) In item 1b, report the number of persons employed by the company in all activities in the 50 States and the District of Columbia during the pay period which includes the 12th of March 1987.

This figure would be the same as that shown by the company in item 1 of Treasury Form 941, if the company filed one form 941 for the entire company.

Item 2 — Show all costs incurred within the company for wages and salaries, direct material costs, services and supporting costs, and an appropriate share of company overhead to conduct research and development activities.

Under Federal funds, include research and development in procurement as well as research and development contracts and research and development subcontracts. Exclude research and development subcontracted to others.

Remarks (Continued)

Name of person to contact regarding this report		Address (Number and street, city, State, ZIP Code)		Telephone (Area code, number, extension) 993	
CERTIFICATION — This report is substantially accurate and has been prepared in accordance with instructions					
Name of company		Address (Number and street, city, State, ZIP Code)			
Signature of authorized official		Title		Date	

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE \$300

RETURN THIS COVER SHEET TO ROOM 233. IF YOU DO
NOT WISH TO RECEIVE THIS MATERIAL ☐ , OR IF
CHANGE OF ADDRESS IS NEEDED ☐ , INDICATE
CHANGE. INCLUDING ZIP CODE ON THE LABEL. (DO
NOT REMOVE LABEL).